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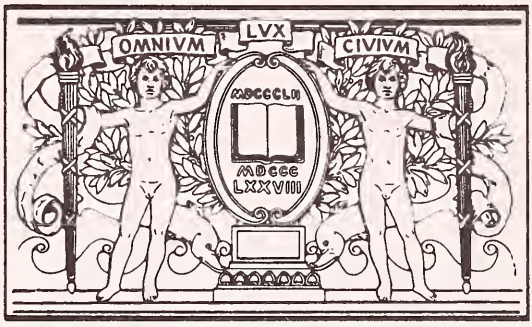

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The Commonwealth of Massachusetts.

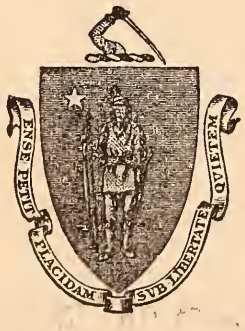
PUBLIC IMPROVEMENTS FOR THE METROPOLITAN DISTRICT.

REPORT

OF THE

COMMISSION ON METROPOLITAN IMPROVEMENTS

APPOINTED UNDER RESOLVES OF 1907, CHAPTER 108,
TO CONSIDER THE SUBJECT.



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1909.

Metropolitan Improvements Commission.

APPOINTED BY THE GOVERNOR.

BENJAMIN N. JOHNSON, *Chairman.*
HENRY B. DAY.
DESMOND FITZGERALD.

APPOINTED BY THE MAYOR.

THOMAS J. GARGAN.[1]
ROBERT S. PEABODY.

SYLVESTER BAXTER, *Secretary.*

---

[1] Deceased July 31, 1908.

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LEGISLATION.

CHAPTER 108, RESOLVES OF 1907.

RESOLVE TO PROVIDE FOR THE APPOINTMENT OF A COMMISSION TO INVESTIGATE THE SUBJECT OF PUBLIC IMPROVEMENTS FOR THE METROPOLITAN DISTRICT.

Resolved, That the governor, by and with the advice and consent of the council, shall appoint three persons, and the mayor of the city of Boston shall appoint two persons, who shall together constitute a commission of five for the purposes hereinafter named. The chairman of said commission shall be designated by the governor. The said appointees shall serve without compensation, and shall be persons of recognized qualifications and large experience in respect to one or more of the following subjects or professions, namely: finance, commerce, industry, transportation, real estate, architecture, engineering, civic administration and law. Said commission shall investigate and report as to the advisability of any public works in the metropolitan district which in its opinion will tend to the convenience of the people, the development of local business, the beautifying of the district, or the improvement of the same as a place of residence. It shall consider the establishment of a systematic method of internal communication by highways, the control or direction of traffic and transportation, and the location of such docks and terminals as the interests of the district may demand. It shall recommend the method of executing and paying for such improvements as it may suggest, and shall make such maps, plans and estimates of cost as may be needed for its investigation, or for the proper presentation of its conclusions, and may employ such assistants therefor as it deems necessary. The commission may expend such sums of money, not exceeding twenty-five thousand dollars, for clerical, expert and other assistance, and for other incidental expenses, as it deems necessary. The commission shall make its final report to the governor and to the mayor of Boston on or before the first day of December, nineteen hundred and eight, and its powers and duties shall then terminate. The governor shall transmit the report to the general court of the year nineteen hundred and nine. The expenses incurred under the provisions of this act shall be assessed upon the metropolitan parks district.

Approved June 15, 1907.

CHAPTER 143, RESOLVES OF 1908.

RESOLVE RELATIVE TO THE COMMISSION APPOINTED TO INVESTIGATE THE SUBJECT OF PUBLIC IMPROVEMENTS FOR THE METROPOLITAN DISTRICT.

Resolved, That the time at which the commission to investigate the subject of public improvements for the metropolitan district, appointed under chapter one hundred and eight of the resolves of the year nineteen hundred and seven, was required to report by the said chapter is hereby extended until the fifteenth day of March in the year nineteen hundred and nine; and the commission may expend for the purposes stated in said chapter an additional sum not exceeding ten thousand dollars. The expenses incurred under this resolve shall be assessed upon the metropolitan park district. *Approved June 13, 1908.*

Report of Commission.

To His Excellency the Governor of the Commonwealth of Massachusetts and to His Honor the Mayor of the City of Boston.

The commission appointed in pursuance of chapter 108 of the Resolves of the year 1907, since generally described as the Metropolitan Improvements Commission, hereby submits its report.

The purpose of the commission was expressed by the Legislature as follows: —

> Said commission shall investigate and report as to the advisability of any public works in the Metropolitan District which in its opinion will tend to the convenience of the people, the development of local business, the beautifying of the district or the improvement of the same as a place of residence. It shall consider the establishment of a systematic method of internal communication by highways, the control or direction of traffic and transportation, and the location of such docks and terminals as the interests of the district may demand.

Authority was given to employ such clerical, expert and other assistance as might be deemed necessary. The limit of time within which the commission was required to make its report was originally fixed as Dec. 1, 1908. By chapter 143 of the Resolves of 1908 this time was extended to March 15, 1909.

Soon after its appointment the commission selected Mr. Sylvester Baxter as its secretary, and proceeded to give very general notice of its organization and readiness to receive information or suggestions from any citizen who could assist the commission in arriving at sound conclusions. Written information and requests to that effect were especially sent to the mayors of cities and the selectmen of towns, as well as to all known boards of trade, improvement societies and other similar associations within the Metropolitan District. Several hundred written requests for suggestions and assistance were

likewise sent to those citizens of the Commonwealth who were known to have made a study of or to have shown interest in any of the lines of inquiry entrusted to the commission. All these notices and requests were accompanied by a printed copy of the resolve establishing the commission, thus disclosing fully the nature and scope of the subjects to be considered.

Since its appointment the commission has held regular meetings, usually twice in every week. It also gave several public hearings, which were widely advertised and afforded every citizen an opportunity to be heard on any question which he deemed to affect the public interest. In pursuing its investigations the members of the commission from time to time personally visited many points of interest in the district, and thus made direct study of the plans of improvement that were brought to their attention. In the same way they inspected the railroad terminals in Boston, both for freight and passengers, as well as the water terminals, unoccupied water frontage, sites for docks and industrial development, and other features of the harbors of the district.

The comparative study of modern seaports and their facilities was greatly aided by the circumstance that Mr. Robert S. Peabody, one of the members of the commission, immediately after his appointment devoted the late summer and autumn of 1907 to the study of municipal and port improvements in leading European cities. The results of his studies were embodied in a pamphlet published by the Boston Society of Architects.[1] In the summer of 1908 Mr. Desmond FitzGerald, the engineer member of the commission, devoted many weeks to the investigation of port conditions in the foremost commercial cities across the Atlantic. The conclusions of his studies in that regard appear in a special report to the commission, which, with recommendations and plans for an ultimate system of docks and terminals, is presented herewith.

The commission sustained a severe loss in the death of the Hon. Thomas J. Gargan, one of the two members of the commission appointed by the mayor of Boston. Mr. Gargan died

[1] A Holiday Study of Cities and Ports. By Robert Swain Peabody. Notes of Travel offered to the Commission on Improvement of Metropolitan Boston by one of its members. Published by the Boston Society of Architects, 1908.

in Berlin, Germany, July 31, 1908. His last attendance at a meeting of the commission was on April 22, 1908. Although at that time he had been seriously ill for many weeks, he showed a constant interest in the work of the commission, and on parting with his associate members expressed the hope that he might secure valuable information for their use by his studies in Germany during the summer. His knowledge of rapid-transit conditions, gained by long service as a member of the Boston Transit Commission, had made him a most valuable member of this commission, and his loss was particularly felt in connection with the study of transit matters.

The services of several experts were secured to assist the commission in the course of its investigations. The study of the present steam railroad systems and their terminals within the district, for the purpose of ascertaining what improvements therein are required for the best public service, was entrusted to Mr. George R. Wadsworth, civil engineer. The study of the topography of the district, with a careful examination of the general scheme of its connecting highways, and their sufficiency as a means of such internal communication was assigned to Mr. Arthur A. Shurtleff, landscape architect. The consideration of the feasibility of constructing artificial water ways or canals in Massachusetts, and their possible relation to the development of the commerce of the port of Boston, was assigned to Mr. Richard A. Hale, civil engineer. The reports of these three experts are presented herewith. A valuable description of the water front of Boston Bay, prepared by the secretary of the commission, also accompanies this report.

A statement of the financial condition of the Metropolitan District, in tables A, B and C, is made a part of this report. These tables have been prepared under the direction of Mr. Henry B. Day, a member of the commission.

The Subjects considered.

The scope of investigation entrusted to the discretion of the commission is a very broad one; indeed, it is almost as comprehensive as the whole question of the public welfare and

progress of the Metropolitan District. This surely includes the interests of the entire Commonwealth. For while the Legislature has from time to time set apart certain cities and towns as constituting, with Boston, a Metropolitan District, for the purpose of establishing an adequate system of parks, sewers or water supply, such legislation has never in any degree implied a doubt that the interests of every portion of Massachusetts are inseparably involved in the interests and welfare of every other portion. Such tentative divisions into metropolitan districts have been principally for the purpose of securing unity of administration in these important branches of public works. The only practical limitation of inquiry to be found in the resolve establishing the commission is in the definition to be given to the term "public works," and this, upon a fair interpretation of so comprehensive a resolve, would probably include almost any public undertaking.

The range of permissive investigation thus suggested presents a life work for any man or body of men who should undertake to cover it. It was therefore manifest to the commission from the beginning that only a few selected subjects could be adequately studied, and that even the study of these must, to a considerable degree, be preliminary rather than final. The commission nevertheless imposed no limitation or restriction upon the subjects which any citizen desired to discuss before it, and many suggestions were made and theories proposed with reference to which it has proved to be impossible to reach a definite conclusion. In this report the commission deals only with those matters which it regards as of most immediate concern to the public.

An analysis of the resolve providing for the appointment of the commission discloses at once a clear distinction made therein by the Legislature between those "public works" generally which, in the opinion of the commission, will tend to the betterment of the Metropolitan District in any way, and certain specific subjects which the resolve makes it mandatory upon the commission to consider. The subjects thus definitely assigned for study and investigation were "the establishment of a systematic method of internal communication by highways,

the control or direction of traffic and transportation, and the location of such docks and terminals as the interests of the district may demand." It is obvious that these matters, thus set apart from all others for special examination, are, in their proper relations, but different phases of the one great question of transportation. Docks and terminals are necessary and component parts of any modern system of railroad or water transportation. The securing of a better system of internal communication by highways between the various portions of the Metropolitan District is but another branch of the same comprehensive subject. Highway movement is essentially one of traffic and transportation, and it is the highways that supply the principal routes for street-railway and rapid-transit lines.

The Paramount Question.

In view of the wide variety of subjects which were open for discussion before the commission it was a notable fact that inquiries throughout the Metropolitan District, as well as the statements made and evidence offered at the various hearings, disclosed it to be the very general belief of the public that the question of transportation was the most urgent one to be considered, and that the future commercial and industrial interests of the Metropolitan District, and therefore of Massachusetts, depended in great measure upon its proper solution. In other words, the inquiries of the commission and the hearings before it developed the fact that there was a complete concurrence between the opinion of the Legislature as expressed in the resolve and that of the public generally, to the effect that the great problem of transportation in its various phases was the one which most vitally affects the interests of the Commonwealth, and was therefore the subject which it was most essential that this commission should investigate.

It was also worthy of note that by very general agreement the growth and development of the city of Boston as a commercial port were deemed by those who appeared before the commission to be the matter of supreme importance. Indeed, it was agreed upon by all, even by those who differed on almost every other subject, that the commercial and industrial future

of the Metropolitan District is intimately and inseparably involved in the future growth and prosperity of Boston, and that the promotion of the interests of Boston is of vital moment to the entire Commonwealth. If Boston is to rise to its opportunities and maintain its place as the second seaport of importance in the country, then commercial and industrial development throughout the Metropolitan District will surely follow. If, on the other hand, through any lack of public spirit, enterprise or civic courage, Boston should be permitted to lag in its development, and lose its opportunities to share in the rapidly growing commerce of the North Atlantic, such retrogression will inevitably result in a similar lack of development throughout the State. Speaking more specifically, the very general opinion was disclosed that questions of traffic and transportation, and of docks and terminals, must for the present at least be studied with reference to Boston, the commercial and industrial center of the Commonwealth. It appeared to be recognized on every hand that the achievement of the best facilities in that regard for Boston would inevitably prove an achievement benefiting the wider areas of territory and the more comprehensive commercial and business interests which the commission was instructed to consider.

Detriment of Conflicting Views.

While it was thus generally agreed that the future of Boston is to dominate and determine in great measure the future of the Metropolitan District, there were widely differing opinions with regard to what commercial development is possible for Boston, and as to how far that development may be or should be aided by public co-operation. These views varied from the pessimistic opinion that the port of Boston is ultimately to decline in relative commercial importance until it becomes a merely local port for eastern Massachusetts, to the optimistic prophecy that with adequate railroad and terminal facilities it may become one of the greatest of the world ports.

In forecasting or planning for the development of a city, commercially or otherwise, it would be a serious blunder to

ignore the psychological significance of such widely differing points of views of the city's future. The mental attitude of the citizens of any community towards its growth and future prosperity is an element of no mean importance in the shaping of its destiny. Confidence and civic courage have frequently had the power to achieve that which doubt and hesitation would have rendered an impossibility. In the case of Boston it is difficult to say which class of men has been the greater embarrassment to its progress and commercial development. Sometimes it has appeared to be those who blindly assert that everything in Boston is good enough, and that no progress, development or change is necessary. At other times it has seemed that the greater obstacle encountered is in the attitude of those who repine that, while Boston has had great opportunities in the past, these have been neglected and permanently lost, and that the future contains little promise of growth or progress.

There is an additional element of difficulty in the fact that whenever the condition of Boston's commerce, or the question of securing its growth and development, is presented to any body of Massachusetts men, there are at once encountered two antithetic points of view as to how the necessities of the future are to be met. One of these will voice itself in the assertion that all is well; that Massachusetts and Boston have had a glorious past and have always steadily grown in population, wealth and industry; that the only wise course is to let well enough alone; that prosperity and growth and the development of industries never seek, or follow after, the establishment of commercial and industrial facilities, but, on the contrary, advance by their own inherent strength and create the demand for and secure such facilities as the direct result of that demand. The opposite point of view is invariably expressed by those who have made a study of the commercial ports of the world which have shown the greatest growth in recent years and which to-day clear the largest tonnages. They say that an examination of the history of such ports in Europe during the last twenty-five or fifty years indicates clearly that these ports have not depended merely upon chance or destiny, but that, on the contrary, the great and unexampled prosperity which has come

to them has in considerable measure been the immediate result of the progressive spirit and civic courage of their people, followed by a systematic and scientific study of port conditions, and the furnishing at tremendous expense of the best modern facilities for foreign commerce. They say further that if we turn from Europe to America it will be only to find that from Montreal to Rio de Janeiro and Buenos Aires there is everywhere manifest the recognition that, in order to participate to any great extent in modern commerce, adequate and up-to-date harbor facilities must be provided. They point out that the city of Montreal, which is 1,000 miles from the open sea, has been taking active measures to extend its tonnage, until the whole water front is now owned and controlled by the city, and the port has become the leading summer port for the export not only of Canadian but of American grain. They also call attention to the fact that New York, with all her pre-eminent natural advantages, has left nothing to chance, and that to-day substantially the entire water frontage of Manhattan Island is owned by the city and in charge of its department of docks.

Thus we are confronted, as already stated, in every discussion of Boston's future, by the *laisser-faire* policy on the one hand and the progressive spirit on the other. There seems to have been in Massachusetts a perpetual struggle between them, with a sort of stand-off as the result, which unfortunately works out in almost every instance as a substantial victory for the *laisser-faire* spirit.

Period of Awakening and Inquiry.

The year 1907 was peculiarly a period of awakening, of self-criticism, of anxious questioning whether all was indeed well with the State and metropolis, and whether sufficient effort was being made to encourage and promote their future and industrial progress. In that one year at least twelve representative organizations of Boston participated in active measures of inquiry whether Boston was in truth living up to its present opportunities, and doing what was necessary to meet the demands of the future. These organizations were the Boston Chamber of Commerce, Associated Board of Trade of

Boston, Boston Merchants Association, Boston Real Estate Exchange, Boston Clearing House Association, Boston Central Labor Union, Citizens' Association of Boston, Boston Society of Architects, Boston Society of Civil Engineers, Boston Board of Underwriters, Metropolitan Improvement League, Boston Stock Exchange, and Master Builders' Association. It would be difficult in any city to marshal a like number of organizations with a membership so generally made up of representative men. Upon the action taken by any of these societies there rested not the remotest shadow of self-interest; what they did was prompted from beginning to end by a lofty and disinterested public spirit.

In addition to these many voluntary lines of inquiry as to the condition of the commerce and industries of Massachusetts, and the wiser lines on which to plan and provide for their future development, there were six separate instances of public action taken for the forwarding of these same self-searching inquiries as to what might be the deficiencies, the lack of enterprise, the point of failure and the range of opportunity of the Commonwealth and the metropolis. These six public measures were as follows: March 28, 1907, the Legislature ordered the Boston Transit Commission to investigate the congestion and delay caused by teaming traffic and the movement of freight in Boston, and to report its recommendations; May 28, 1907, the Board of Harbor and Land Commissioners was directed by the Legislature to investigate and report as to the advisability of constructing and maintaining a system of metropolitan docks in the city of Boston, to be owned and controlled either by the Commonwealth or by the city; June 7, 1907, the Legislature gave to the Finance Commission, appointed by the mayor of Boston as authorized by the city council to consider the financial condition of the city, the amplest power to summon witnesses and compel the production of books and papers bearing on that line of inquiry; June 10, 1907, the Legislature authorized a Commission on Commerce and Industry to investigate the present condition and future possibilities of the industries of this Commonwealth, the present condition and future possibilities of transportation, of manufactures

and of industries, and to consider what might be done by legislation, by executive action or by any other means for the exploitation and development of the industries of the Commonwealth; June 15, 1907, the Legislature provided for the appointment of this commission. Besides these five measures adopted by the Legislature, the mayor of Boston, acting in pursuance of an order of the city council, appointed a commission to consider the sufficiency of, and possible improvements in, the docks and water terminals of Boston harbor.

An analysis of the lines of inquiry provided for by these public enactments shows that, while they are manifold, the principal emphasis is laid upon the commerce of the State, — that commerce which is, in whole or in part, water-borne trade. It appears to have been recognized in these enactments that while Massachusetts and the Metropolitan District have achieved much to be proud of in their present parks and similar reservations for recreation, in their systems of sewers and water supply, in their libraries, hospitals and other similar institutions for promoting the education, health and general welfare of the people, there was grave reason to doubt whether there had been proper preparation to secure their fair share of the world's commerce. Especially noticeable is the solicitude manifested in these public acts and resolves as to whether Boston is affording in its harbor sufficiently modern and ample port facilities for the commerce which may be attracted here.

It is difficult to believe that all these public expressions of the same general convictions are to prove only a spasm of self-scrutiny, a brilliant but temporary awakening to the splendid and far-reaching achievements of the other great commercial cities of the world. In view of the recent reconstruction of the Boston Merchants Association into an organization of unprecedented power and influence, and its now assured evolution into a more progressive and powerful Chamber of Commerce, there is every reason to hope that Massachusetts and Boston will be brought to a sound consciousness of their great opportunities, and to the permanent adoption of wise and courageous methods by which these opportunities may be realized.

Commercial Future dependent upon Port Facilities.

The commission is satisfied that the importance which Boston may fairly expect to attain and hold as a commercial city will depend in very great measure upon the efficiency and wise management of its railroads, and upon an appropriate development of its transportation facilities generally. This is equally true of Boston and the Metropolitan District as a great business and industrial center. Indeed, it has become almost a commonplace to point out the fact that there is hardly any industrial area in the country the interests of which are to so great an extent dependent upon the expedition and economy with which transportation is effected. The raw material for our great manufacturing industries is in the main brought from a distance. Practically no part of it is produced on our own soil. Again, an overwhelming percentage of the finished product of these industries is shipped out of New England to the ports and cities of the world. It may be truly said that in comparison with its manufacturing output Massachusetts produces nothing but the constructive and organizing ability of its business men and the skilled labor of its artisans, who, through their combined efforts, receive the raw material from a distance, make it up into the finished product and ship it again to far-off points. Vital to the welfare of such a community is, and always must be, the effectiveness and excellence of its transportation system.

Famous though Massachusetts is for the high class of its manufactures, and for the skill and adaptability of its workmen to devise new methods and to achieve still higher skill through industrial training, there is nevertheless a limit to the amount which any manufactured commodity can stand in the way of transportation charges. If the cost of securing coal and raw material at the factory and of shipping the completed product from the factory to the railway car or outgoing steamship more than offsets the superior quality of the article, there will be no market in which that article can be disposed of at a profit. Under modern conditions excessive cost of transportation is likely to be found in charges for handling and transfer rather than in those for carriage. It is there that we must look

for reduction in cost. Every unnecessary item in the way of local charges for handling or transferring freight reduces the distance to which the manufactures of Massachusetts can be profitably shipped. On the other hand, every saving in such local charges will correspondingly extend the radius within which Massachusetts may successfully compete with other States or countries. It requires only a comparatively moderate extension of such radius to bring within the circle of our industrial and trade relations millions of possible consumers otherwise cut off from our field of competition.

The foremost commercial asset of Boston is its excellent harbor. It is one of the few natural gateways for the great flow of ocean commerce between Europe and the United States. Through the North Atlantic ports, limited in number, this constantly growing stream of water traffic must pass. How it is to be divided in the future among these ports depends not only upon their respective locations, but fully as much upon their harbor facilities and the general conditions controlling inland transportation from each port. New York holds a supreme advantage in this respect, having not only its own trunk lines to Chicago and the Great Lakes, but direct water connection through the Erie Canal as well. With these ample and competing instrumentalities of inland transportation complementing its extensive and developed water front, there appears to be no question that New York will be able to hold its position as the leading port on the Atlantic, and keep far in advance of all others in the extent and value of its commerce. But however great New York is or may become, it is impossible that any one port can handle all transatlantic commerce. There always have been, and there will continue to be, other ports of considerable importance. Boston is one of them. In its tonnage it is second alone to New York. While Boston may properly seek to bring its commercial importance closer to that of New York, its real competition as a North Atlantic port is hereafter to be not so much with New York as with Montreal, Philadelphia and Baltimore.

The share which Boston is to have in the great commerce which is to be distributed among these North Atlantic ports depends in great measure upon the spirit of its people as applied

to the problems and conditions of commercial development. Boston is already a great commercial port. Near its gateway flows one of the largest streams of ocean commerce. Its tributary land areas include not only all of New England, which is by no means inconsiderable, but, looking farther, the rich and fertile harvest fields of our own west and the great Canadian northwest, which latter has become one of the grain-producing centers of the world. The commission believes that by intelligent adaptation of the facilities of Boston harbor to the demands of modern commerce Boston may not only retain the volume of business which it now has, but, as the great current of trade between western Europe and our North Atlantic coast develops, as it is sure to develop to a marvellous degree, will be able to secure a very large share of the increasing commerce. As a North Atlantic port Boston possesses on its water side numerous and essential advantages. It is 180 miles nearer to the great ports of Europe than any other leading North Atlantic port. It has excellent frontages for the construction of modern docks and piers; it has deep and excellent channels for harbor approach; and it possesses the inestimable advantage of having a harbor not only thoroughly protected but in close proximity to the open sea. Nature has thus done everything that is required, so far as water approaches are concerned, to make Boston one of the world's great ports.

Transportation Efficiency a Terminal Problem.

It is frequently said that the conditions controlling inland transportation from Boston seem in a measure to offset rather than complete the natural advantages of its harbor. There is no doubt some disadvantage in the fact that the railroad haul between the west and Boston is over fairly severe grades, which add appreciably to the actual cost of transportation. But the grades to be overcome by railroads between the west and either Philadelphia or Baltimore are far more severe than between the west and Boston.[1] It is claimed that the lack of a through

[1] The Pennsylvania Railroad crosses the Alleghanies at different elevations for the eastbound and westbound tracks, owing to the separation of grades at the summit. The summit for the eastbound track has an elevation of 2,192.6 feet, and that for the westbound track is 2,161.4 feet. The maximum eastbound grade is 1.3 per cent, and the maximum westbound grade is 1.86 per cent. The Baltimore & Ohio crosses the same range at a max-

trunk line to the west and the Great Lakes and the Canadian northwest deprives Boston of that certainty of commercial growth to which her harbor and her water front would otherwise give her assurance. There is no railroad out of Boston which can reach Chicago or any of the Great Lake ports without a connection over railroads which have no direct interest in Boston. At the hearings before the commission there were many theories advanced and suggestions made as to how Boston might secure such a direct and independent trunk line to the harvest fields of the west and the Canadian northwest, or in some equivalent way complement the invitation which its splendid harbor extends to transatlantic commerce. It is undeniably a question which materially affects the future of Boston. The duties of the commission, however, being expressly limited to the study of public works within the Metropolitan District, the control and direction of the trunk lines between Boston and the west were not deemed to be within the authorized scope of its investigations. The commission has considered it to be its duty to examine more closely into questions of transportation as they are presented by existing conditions within the Metropolitan District. But this limitation is by no means unfortunate, because there are many things which may be done within the district that will not only minimize but very largely counterbalance any disadvantage under which Boston is supposed to be placed by its lack of control of through trunk-line transportation. The things which may thus be accomplished to Boston's great advantage relate to the improvement of its terminal facilities.

So far as the problem of bringing the railroads and other transportation facilities of Boston to the standard of efficiency required by modern views of economy and commensurate with Boston's potential future is to be solved by improved or additional instrumentalities within the Metropolitan District, it must

imum altitude of 2,620 feet, and 19 miles to the west is another elevation of 2,550 feet. The maximum eastbound grade is 2.2 per cent. The Chesapeake & Ohio Railway crosses the Alleghanies at an elevation of 2,064 feet, with a limiting grade of 30 feet to the mile for eastbound freight, while for the westbound freight the limiting grade is 60 feet to the mile. The Boston & Albany crosses the Berkshires at an altitude of 1,453 feet, with a maximum eastbound grade of 1.4 per cent., while the maximum westbound grade is 1.6 per cent. The maximum grade of the Fitchburg Division of the Boston & Maine is at East Gardner, where the summit has an altitude of 1,106 feet, the summit at the Hoosac Tunnel being only 836 feet. The maximum eastbound grade is 1.29 per cent., or 68 feet to the mile.

be largely, if not altogether, a terminal problem. The efficiency of every transportation line entering Boston, whether by rail or water, is in great measure limited by the adequacy and arrangement of its terminals. Judged by modern standards, the efficiency of a railroad depends no more upon the length and quality of its roadbed and the character of its equipment than upon the adequacy and excellence of its terminals. As a chain is no stronger than its weakest link, so a railroad can be no more efficient than its terminals permit it to be. Confusion or rigidity of movement in a terminal situation will produce the same confusion and absence of flexibility throughout the entire transportation line using that terminal. It is because of this now generally recognized importance of adequate terminals as an integral part of every modern transportation system that the largest expenditures by railroads at the present time are being made to secure better terminal facilities. Boston, being pre-eminently a seaport, its terminal facilities for maritime business, in their proper development, arrangement and administration, are to be recognized as no less essential to its growth and prosperity than those of the inland transportation systems.

The existing terminal facilities of Boston, indeed the whole railroad situation controlling the movement and distribution of freight in and around the city, is the direct outcome of the situation of twenty-five years ago, when there were eight distinct railroad companies each with its separate terminals for freight and passengers. As eight railroad managements then dealt with these important traffic operations, each from the standpoint of its own interest or convenience, so to-day three railroad managements are doing the same thing. There has been no united effort or plan for raising the freight terminals to the modern standard of efficiency or economy. They require radical improvement if the future commercial opportunities of Boston are to be met. The water terminals are mainly owned and controlled by the railroads and other transportation lines. They are already becoming congested to the point of interfering with the despatch and economy of business, and are in no way comparable in their arrangements and facilities with those of many other cities of less commercial importance. Whether these de-

ficiencies in terminal facilities have already retarded the commercial growth of the city is a question which may not reward discussion, but certain it is that the existing railroad and harbor terminals as now arranged and administered offer slender encouragement to the legitimate aspirations for the future.

Greater Boston as a Terminal District.

Greater Boston being in effect one terminal district, the proper improvement and development of its terminal facilities should be treated as a single problem. The present arrangement of separate and independent freight terminals for the several railroads and lines of water transportation should be abandoned, and in its place there should be adopted a comprehensive plan for a flexible and efficient system of interchange terminals, whereby commodities, whether in carload or cargo bulk, or in lesser lots, may be delivered and transshipped from railroad to railroad, or from land to water, or *vice versa,* and distributed among consignees, with the highest attainable expedition and economy. The establishment of such a system of interchange terminals is of the greatest importance to Boston. The controlling features of such a system should be direct and effective connection between all lines of railroad entering the city and every portion of the terminal system, as well as access to and use of the system and its facilities by every railroad on equal terms for like service.

Such a system necessarily involves some well-considered plan of water-terminal improvement. Boston for many years has been without any definite plan for harbor development or for the correlation and efficient connection of its terminals. With a few notable exceptions, the wharves and docks of Boston are of insufficient length to accommodate steamships of the size and type now coming into general use. The wharf sheds are mostly of wooden construction, inviting frequent conflagration. Not only should the docks be longer and wider, but the piers should be wide enough to afford ample room for streets, warehouses or freight sheds and railroad tracks. It appears very probable that between the great ports North Atlantic business will soon be done almost entirely by steamships of the combination type,

— large passenger steamers carrying freight. Docks that are to be built should be arranged to a considerable extent for the accommodation of passenger business as well as freight business. The very fact that so much passenger business has heretofore come to Boston, despite such inadequate facilities, demonstrates that better facilities are demanded, and that the passenger business under reasonably favorable conditions may be expected to show a large increase. It is certainly a matter of congratulation and encouragement that the shipping of Boston harbor has so well maintained itself with so little consideration or assistance from the public. The persistence of business under disadvantageous terminal conditions leads to the reasonable conviction that with advanced facilities the port of Boston has a promising future. But harbor terminal facilities must be furnished through private enterprise or by the Commonwealth or municipality, or by a combination of these authorities. In view of the lack of co-operation on the part of the public authorities, the railroads are to be commended for their enterprise, not only in furnishing dock and terminal facilities, but in actively encouraging connecting steamship lines. Without this the port would long since have come to a commercial standstill.

The federal government has made it an invariable rule to expend nothing in the development of terminals or harbor facilities. It has, however, been very generous in improving the channels and water ways of the harbor, and has made large expenditures for that purpose. In addition to this, the Commonwealth between 1870 and 1908 inclusive expended $4,781,435.15 in harbor improvements, represented mainly by dredging and related work. The city of Boston itself, on the other hand, has for many years done nothing worthy of note in developing its harbor. Added to this comparative neglect on the part of the city, many undertakings, private as well as public, have been established on the water front of the harbor which may seriously hamper and restrict its complete or ideal treatment in the future. Defective facilities and disordered conditions have been allowed to remain unremedied, although their injurious effect upon Boston's commerce has been repeatedly recognized and brought to the public attention.

The progressive ports of the world have adopted the contrary policy, and it is now becoming generally recognized that the wise administration of any port requires that it shall plan its facilities and arrangements ahead of present demands, and thus be prepared to meet whatever the immediate future may require.

Less important commercially than the improvement of freight and water terminals, but of prime consequence to the welfare and safety of the people, is the early adaptation of the railroad passenger terminals in Boston to modern requirements. The geographical position of Boston, its congested territory and the habits of its people make it the one city above all others which requires well-ordered, rapid and comfortable suburban transportation. The electrification of all railroad passenger lines in the Metropolitan District within the next few years is highly probable. Changes in present terminal structures and arrangements — whether with reference to freight or passenger terminals — should therefore be carefully studied, with due regard to that probable and far-reaching change in traction methods and its inevitable effect upon terminal problems.

Freight Terminals radically reformed.

The first and most important step of progress must be a general recognition by the public that these matters are of vital interest, and that they are to be dealt with as different but essential features of the one problem of transportation as applied to a commercial and industrial center. A complete and comprehensive plan of improvement should be worked out to a finality, in order that when the plan is at length adopted there shall be no doubt of its effectiveness or feasibility. The studies of the commission have necessarily been preliminary; no detailed engineering plans or estimates of cost of suggested improvements and developments have been made. The many lines of investigation entrusted to the commission have not left it sufficient time or money for the preparation of such plans or estimates. Final studies should be along the broadest and most intelligent lines, without restriction as to any reasonable expense. The essential thing is to have a plan that is known to

be right, and then to follow it without substantial deviation as soon as conditions, financial and otherwise, permit. The main purpose is to secure an adequate ultimate development of terminal facilities for the transfer, delivery and distribution of freight, and the requisite improvements in the Boston passenger terminals.

Belt-line Connections.

A belt line around Boston, connecting the various lines of railroad and more important still the marine terminals on the north and south sides of the harbor, has been repeatedly suggested as the best method of securing prompt and flexible freight movements in the Boston terminal district. There is no question that in many cities such a belt line has proved effectual and satisfactory to that end. A belt line certainly facilitates interchange among railroads. In the case of inland cities like Chicago and Cleveland, where there is a heavy through freight traffic, such a line around the city is absolutely necessary to avoid the running of trains through the more densely populated areas. When freight is brought to Boston, however, it is brought here principally to transship or dispose of it, not to carry it to points beyond. Boston is essentially a terminal city. The situation of every city must be studied by itself. Each presents unique conditions and consequently has problems peculiar to itself. If it were practicable to construct around Boston a belt line of reasonable length and permissible cost, thus effecting a direct and economic connection between the water terminals of East Boston and Charlestown on one side of the harbor and those of South Boston on the other, this commission would undoubtedly recommend the construction of such a line. A careful study of the situation, however, with an examination of the several possible routes for such a belt line, has convinced the commission that it is not feasible. This conclusion has been reached not only because the locating of such a line outside the circumference of prohibitive cost and unwarranted interference with present public institutions and utilities would so lengthen it as to render its use cumbersome rather than helpful, but also for the reason that a study of the whole situation has brought the commission to the conclusion that such a belt line is un-

necessary. It is believed that all the benefits which such a line could be expected to achieve may be effected in another and less expensive way.

A Terminal Improvement Plan.

The commission, after studying many alternative suggestions for improving the freight and passenger terminals, considers the plan embodied in the report of its engineer, Mr. Wadsworth, as the most thorough and practicable plan which has been brought to its attention. It is to be noted throughout the discussion of this plan, both with reference to the arrangement of freight and passenger terminals, that it presupposes and is conditioned upon the electrification of all passenger lines entering Boston.

With reference to freight terminals, the principal and controlling features of the plan suggested are: (1) The development of several of the existing freight-receiving yards around Boston and the relocation of yards for the lines of the Boston & Maine Railroad. (2) The establishment of a clearing yard, with modern facilities, in Somerville, on the northerly side of the land now owned by the Boston & Maine Railroad, and formerly that of the McLean Asylum. (3) The improvement and development of the Grand Junction Railroad, including a partial relocation through the clearing yard, into a connecting line, serving all the present lines of railroad entering Boston on the north and west sides of the city. (4) Reconstruction to increase the effective capacity of the Union Freight Railroad and its extension across the Charles River, thus securing, together with the Grand Junction Railroad (developed and improved as above with clearing-yard service), the substantial advantages of a belt line connecting the railroads. (5) The construction of a new marginal railroad along the east water front of East Boston, adjoining the present location of the Boston, Revere Beach & Lynn Railroad, this marginal railroad to be connected with the Grand Junction Railroad, as shown on the plans, and thus with the clearing yard and all entering lines. The proposed East Boston Railroad along the west water front of East Boston, if constructed, should also be connected

with the Grand Junction Railroad, and would not only be an important addition to water-front facilities, but would involve fair promise, ultimately, of a railroad around the entire water front of East Boston. Upon adoption by the Boston, Revere Beach & Lynn Railroad of the standard gauge, which seems probable in the early future, that road could be likewise connected with the entire terminal system, and thus furnish freight facilities to Winthrop (which with its 8,000 inhabitants has never heretofore enjoyed such facilities) as well as to considerable portions of the town of Revere, which would thus be better served than at present. (6) The establishment of a regular and efficient system of car floats between the railroad terminals on the north side of Boston harbor and those on the south side, thus effectively supplementing the function to be performed by the Union Freight Railroad. (7) The development of additional yards for the delivery of freight in and around Boston, and the establishment of a system of district delivery, whereby consignees shall have the right, upon notice given at the time of issue of bill of lading, to have deliveries made in any one of such districts; this selective right to apply to all shipments of commodities to "Boston delivery."

The commission believes that the establishment of such a terminal and delivery system as that above outlined would result in a high degree of flexibility in traffic, in more speedy deliveries and distribution of commodities, whether in carload lots or lesser bulk, and in ultimate economy in all freight movements within the Metropolitan District. By such a system of terminals, transfer and switching charges in the terminal district would become obsolete, and heavy trucking and carting through the streets of Boston would be sensibly diminished.

In its details the above-outlined development of terminals must be considered in great measure as tentative. Final engineering studies would suggest modifications and improvements. The work when at length undertaken would progress gradually, and would have to be so prosecuted as not to interfere with existing traffic.

Advantage of Transfer by Lighters.

In this connection the commission recommends very strongly the more general introduction and use of lighters in the transfer of package freight from one water terminal to another. What more than anything else makes Boston streets congested is the mode of transportation between terminals. It was stated before the commission by an expert on transportation that Boston was the only city he knew of on the Atlantic coast where traffic between water and rail, between rail and rail, and between water terminal and water terminal was almost universally done by teaming. As an illustration of the disadvantage of transporting coastwise freight from one water terminal to another by trucks and teams through the streets rather than by lighters, it was testified before the commission that one coastwise-transportation line finds it necessary to have in Boston 600,000 square feet of floor space, while in Baltimore, where it handles more than twice the amount of freight handled in Boston, it requires only a floor space of 300,000 square feet. It was brought out that the excessive space thus needed in Boston is wholly the result of the congestion caused by teams.

In view of the far greater economy in moving freight by water as compared with carting it through the city streets, it is difficult to understand why the use of lighters for that purpose has been almost wholly ignored in Boston. The inner harbor is especially well adapted to their use. The towage would be short, while the route for carting is both long and crowded. The development of terminals on the opposite sides of the harbor and along Atlantic Avenue seems to require a general lighter service. The only apparent explanation of the nonuse of lighters in Boston is to be found in the former attitude of some of the railroads, which, having first arranged the facilities of their water terminals wholly with reference to deliveries of freight to trucks or wagons, have neglected subsequently to provide suitable arrangements for transshipment to and from lighters. For this reason, in many instances railroads have refused to bill freight from any point on their roads destined to coastwise lines of transportation, except via

their forwarding companies. The commission believes that all terminal facilities necessary or reasonably convenient for the general introduction of lighter service should be early installed, and that freight should be billed in such a way as to permit its being forwarded by lighters.

To reserve Flats for Future Dock Systems.

For use in connection with the development of an adequate system of terminals, and largely as a measure of protection to the future commercial interests of Boston, and therefore of the Commonwealth, the commission recommends the immediate and permanent reservation of a portion of the area of flats lying east of East Boston and adjoining the tide-water terminals of the Boston & Albany Railroad as the best location for such docks, piers and other terminal structures as the future commercial growth of Boston may demand. The portion of such flats which the commission recommends to be thus permanently reserved is clearly designated in the accompanying report of Mr. FitzGerald, as well as in the plans and maps thereto appended.

For the same reason the commission recommends the permanent reservation of the flats owned by the Commonwealth on the south side of Boston harbor, adjoining the Commonwealth Pier, for the location of such additional docks, piers and terminal structures or facilities as shall be required on that side of the harbor.

Improved Passenger Terminals.

With reference to securing a better arrangement for passenger terminals in Boston and more flexible and satisfactory movements of passenger trains entering and leaving such terminals the commission has considered many plans and suggestions. There can be no doubt that the present North and South passenger stations are becoming increasingly congested. Their reconstruction will be a necessity in the early future, and a direct connection between them is highly desirable. The suggested abandonment of the present stations and the establishment of one great central passenger station in their stead

does not meet with the approval of the commission. There is a limit to advantageous concentration both within the station itself and with reference to the overcrowded street conditions which inevitably result from bringing so much traffic to a central point. Various propositions in the way of changing the present site of either the North or South passenger stations, or both, are likewise disapproved by the commission. This disapproval includes the much mooted suggestion of moving the North Station to the other side of the Charles River.

The plan of our engineer for bringing Boston passenger terminals to the modern standard of requirements includes the following cardinal features: (1) Necessary revisions of the South Station and a complete reconstruction of the North Station on their present sites in such a way as to bring all passenger trains into each of these stations on a subsurface level, with the concourse for passengers at street grade, connected with the track platforms below by appropriate stairways and elevators. (2) The establishment of a direct connection by a four-track tunnel between the two stations thus reconstructed. (3) An additional subsurface station in the market district, with entrances and exits near State street.

This plan may appear radical and far-reaching, but it seems to present the most practicable and final solution of the passenger terminal problem so far as it relates to the present steam railroads. The successful installation of this plan would obviate all the present cumbersome and dangerous shifting movements of trains at the various stations, and would result in a flexibility of operation and a measure of convenience to the general public far in advance of anything which Boston has heretofore enjoyed in that regard.

The Boston, Revere Beach & Lynn Railroad has heretofore been a narrow-gauge railroad, transporting passengers only. The location of its present terminus in East Boston constitutes a serious obstacle in the way of a consistent and modern development of the East Boston water front as a whole. It is very likely that in the early future the public will insist upon a tunnel under the harbor that will permit the entrance of the trains of this railroad into the city proper in place of the

present use of ferries. In the development of the above outlined plan for connecting the North and South stations by a tunnel, provision should be made at the proposed market district station for the reception and handling of all the trains of the Boston, Revere Beach & Lynn Railroad, which should enter the proposed tunnel under the harbor north of its present East Boston terminus. With these facilities the trains of that railroad could be turned by a loop at the market district station and return through the tunnel under the harbor to the other termini of the road at Lynn and Winthrop without interruption, thus enjoying the same advantages of metropolitan terminal flexibility as the suburban service in general. The commission considers it probable, as already stated in the discussion of the system of freight terminals, that the gauge of this railroad will be standardized in the comparatively early future.

Financial Considerations.

With reference to the improvements in and extension of transportation facilities hereinbefore discussed, the commission has been dealing with what the commercial and industrial interests of Boston, and therefore those of the entire Commonwealth, fairly require for their highest development. In other words, the commission has investigated and endeavored to reach a conclusion as to what is really desirable, if not actually needed, for the proper development of the Metropolitan District, commercially and industrially. In view, however, of the present indebtedness of the Commonwealth on account of the Metropolitan District, as well as the direct and indirect debt of the cities and towns comprising that district, and the burden of taxation inevitably resulting therefrom both upon the Commonwealth and these cities and towns, the commission is constrained to withhold its recommendation, and therefore does not recommend, that any of the above changes and improvements be undertaken at the present time as public works either by the Commonwealth or by the city of Boston, or through the Metropolitan District as an administrative unit.

An examination of the statement of the financial condition of the Metropolitan District, in tables A, B and C, will show

that the total net direct and indirect debt of the cities and towns in the Metropolitan District (including water loans) is $177,141,094.37, being 8.27 per cent. of their total assessed value, and that the yearly interest and sinking-fund charges on this debt, exclusive of those paid by water rates, amount to 22.57 per cent. of the total yearly running expenses of the municipalities. After conference with a number of the officials of the various cities and towns within the district, the commission has found that nearly all of them regard these existing charges as extremely burdensome. The commission, therefore, recommends that no expenditure requiring a large bond issue shall be made, either by the Commonwealth or by the cities and towns within the Metropolitan District, until such time as this existing debt shall be materially reduced.

How to achieve the Needed Improvements.

It is very important, nevertheless, that the public should reach some definite and comprehensive plan with reference to all these desirable railroad, terminal and harbor developments, in order that they may be carried forward without unnecessary delay. To arrive at such a plan, as a completed study, will certainly require very considerable time and expense, involving engineering details and an exhaustive examination with reference to the matter of cost. The commission recommends that the work of formulating such a plan for ultimate presentation to the Legislature be placed in charge of a commission to be appointed by the Governor and Council, with no other duty than the working out of this great transportation problem, and that no reasonable expense be spared to have the studies of that commission so final and complete as to deserve and secure the fullest public approval.

When, at length, after the final report of such commission, the time shall have arrived for definite action in that regard, the equipment of Boston with a proper system of freight and water terminals, with modern warehouses and port facilities, as well as the reformation of its passenger terminals, should be worked out and completed under public direction. There is probably no practicable alternative. Assuming that such im-

provements could be carried out by a company projected purely as a private enterprise, the transfer and switching charges which a modern terminal system is designed to eliminate would necessarily be continued by such a company as its only source of revenue, and might thereby become perpetuated. The exaction of such charges from the railroads would inevitably evoke their lasting opposition. On the other hand, in so far-reaching a matter, action by the railroads themselves on their own initiative, or effective co-operation among them, is extremely unlikely. This is especially true where there are so many companies owning or operating railroads entering the city. Public direction with railroad co-operation offers the most promising solution of the problem. But such a plan should be, and if it is to succeed must be, made reasonably attractive to the railroads. No effort should be spared to secure their full co-operation with the public on equitable terms. It is eminently fit that so comprehensive a proposition as that of terminal and harbor development should be carried out by the united action of the public authorities and the railroads. They would enjoy in common the benefits of an increasing commerce and business, with the resulting growth in population and in wealth. They should, therefore, participate in bringing these things to pass.

Bearing this view of the matter in mind, the most feasible method of bringing the present inadequate and ill-connected terminals of Boston into one great modern terminal system would appear to be through a terminal company, to be organized and promoted by the joint action of the public authorities and all the railroad companies. The reconstruction of the passenger terminals and their connection by the proposed tunnel, upon the adoption of the above or any similar plan, should be carried out through the instrumentality of the same terminal company. Such terminal company should acquire the terminal properties and sites for terminals now owned by the railroads, with all connecting track lines, so far as they would form an essential or natural part of the proposed terminal system.

Whatever plan may be adopted for acquiring and paying for these properties, its one paramount requisite is that it shall

be perfectly just to railroads and public alike. If a basis of acquisition could be formulated agreeable to the railroads, payment for the properties acquired from them might be made in stock or bonds of the terminal company, or partly in each class of securities. All or a portion of the bonds of the terminal company, as the case might be, could be issued for additional terminal properties and for improvements, construction and developments. To secure the advantage of lower interest rates, and in recognition of its own participation in the whole proceeding, the Commonwealth might very properly guarantee the payment of the bonds of the terminal company, the mortgage securing such bonds to contain proper sinking-fund requirements. Following various precedents, the bonds might with equal propriety be exempted from taxation and made a savings-bank investment. The management of the terminal company should be by the railroads and the Commonwealth jointly, each electing a definite proportion of its board of directors. Terminal operations would thus be controlled and managed in a way that would amply conserve railroad interests and at the same time afford a proper measure of protection to the public. With appropriate legislation there would be no legal obstacle in the way of such joint action by the public authorities and the railroads. Moreover, there ought to be no reason why this should not be entirely practicable.

Public and Corporate Interests should harmonize.

There can be no question that a more friendly attitude of the popular mind toward the corporations controlling many of our great public utilities, the greatest of which is transportation, would aid materially in the solution of many of the momentous problems involved in the commercial and industrial development of the Commonwealth.

With characteristic caution, capital will not risk investment or become involved in public or quasi-public improvements so long as it entertains any reasonable fear that it is to meet, at the hands of the public, with regulation and restriction only, without a corresponding recognition that it is entitled to a fair return upon its venture as well as upon its investment, and

up to that point a right to be reasonably assured of protection and encouragement. To restore the desired measure of confidence in this regard, which must be reciprocal between the public and corporations, it is of the utmost importance that those controlling capital and private enterprise already invested in fields of development where the public has an interest should be consistently regardful of that interest, and unfailingly treat the law and public authorities with due respect and consideration. The public in all these relations holds a position where it may well act upon the principle of *noblesse oblige*. Its power is essentially the greater. It possesses the ultimate authority. The sovereign power of the State to regulate all public-service corporations, and fix the rates to be charged by them for their utilities, is now generally recognized and asserted. Such a power inherent in the State renders impossible any lasting peril to the public interests from corporate infringement. There is, on the other hand, the real danger that many highly desirable public works and improvements which require the co-operation of private capital for their advancement will be seriously retarded unless there can be secured and maintained a greater degree of confidence that these tremendous powers of the State are to be exercised only in the fairest spirit, and always with a deep-seated regard for the essential rights of capital and private enterprise.

Water Ways.

Related to the development of the transportation facilities of any State or city is the question of the practicability of constructing and making advantageous use of artificial water ways. A century ago such water ways, in the shape of canals, were becoming a most important factor in the inland commerce of this country, and Massachusetts was foremost among American commonwealths in undertaking such works. But this class of water ways had long ago ceased to have anything more than a historic interest for us until the recent revival of the subject, which resulted largely from the inability of our railroads to meet the demands forced upon them by the unprecedented growth of traffic throughout the country. The example of Europe in this regard has also been potent in making the subject a prominent

one in all discussions of commercial development. There can be no question that water ways have held a transcendent place in the recent development of the ports of Germany and other European countries. Their importance in that regard can hardly be overstated. This has resulted, in Germany especially, from the singularly parallel course of its great rivers, which afford the most direct and economical method of transportation between the sea and almost every portion of the empire. The number and direction of these superb natural water ways in Germany, reinforced by canal construction, have made it possible to establish a most comprehensive and perfectly connected system of water transportation, serving substantially the entire country. It is perfectly natural, therefore, that in Germany water ways should have become very highly developed in their facilities and use. But the railroads of that country, in their capacity and facilities for moving freight, are comparatively unimportant. This is in a measure true of all continental Europe. In this country, on the other hand, it is the railroads which have been most highly developed, while the water ways have been comparatively neglected.

It has been pointed out in a recent report to the Chicago Harbor Commission that Europe is still living in the era of the 10-ton freight car, while the United States has progressed to the 55-ton car. To be added to these considerations is the fact that the freight rates charged by railroads in the United States are considerably less for their highly efficient service than those charged by European railroads for the comparatively poor facilities which they afford. It is thus evident that the water ways in this country have been subjected to a railroad competition which, in its enterprise and severity, has completely outclassed any competition the water ways of Europe have ever known. In discussing the probable value of an extensive system of canals in this country, therefore, it is necessary that comparisons with European conditions should be carefully made. But whatever the result of such a comparison, there is no question that internal water ways are likely to be of great importance to any commercial city. Not only do they furnish the most economical means of transporting the coarser and lower

grades of freight, like coal and all kinds of foundry and factory supplies, but they represent a competition with the railroads, potential at least, which invariably leads to lower rates. It would be of inestimable advantage to Boston if it might have a water way connecting its harbor with the Connecticut and Hudson rivers, and thus through the Erie Canal with the Great Lakes, in accordance with the studies of Col. Loammi Baldwin which he submitted to the Legislature of Massachusetts, at its request, between 1825 and 1828.

The commission has accordingly examined the practicability of constructing such a canal along this or similar lines, supplementing the investigation of its expert, Mr. Hale, by its own examination in the matter. The result of Mr. Hale's studies, embodied in his most careful report, as well as the conclusion of the commission, is that topographical considerations make such water ways as were contemplated by the old-time projects wholly impracticable, and that under modern conditions the service of Boston by a system of internal artificial water ways is out of the question. Two possible exceptions may be noted. One is the great service which the completion of the Cape Cod Canal might render by making cheaper and safer the prosecution of the great coastwise trade, including the bringing of coal and other similar supplies; the second is the advantage which it is claimed might be derived from the construction of the proposed Brockton and Taunton Canal, between Fore River and Taunton River. Both these projects have been fully examined by other authorities, and the commission has not expended any careful study upon them.

Industrial Sites and the Metropolitan Water Frontage.

An important element in the value of inland canals is the opportunity which they afford for the location along their lines of industrial establishments, which thus have the advantage of a system of water transportation at their very doors. Whether the judgment of this commission as to the probable function which artificial water ways are to perform in the future commercial and industrial development of Massachusetts shall prove correct or otherwise, certain it is that every natural water way

in the State should be improved and used so far as consistent with the preservation and normal expansion of industries already established thereon. Within these limits, every navigable river should be regarded a public asset for such development. But from the point of view of securing most advantageous sites for industrial establishments, the Metropolitan District has a vast wealth of opportunity in its whole water frontage, from Lynn to Weymouth. The European ports in which there has been in the past twenty-five years such unparalleled industrial as well as commercial development could hardly duplicate, either in the number or excellence of their sites for ideal manufacturing conditions, the areas which are comprised within this very water front of metropolitan Boston. In the main harbor alone there are many available sites for industrial districts which, with both water and rail connections, might rival in extent the celebrated Bush Terminal at Brooklyn, New York. In their terminal facilities, such industrial districts established here would be far superior to the Bush Terminal, in that the trunk lines of railroad would come directly to their factories and warehouses, whereas the Bush Terminal has to make its railroad connections through car floats. Then there are Lynn harbor, the vast extent of the Lynn and Saugus marshes, Mystic River, Malden River, Island End River, Chelsea Creek, Old harbor, Dorchester Bay, Quincy Bay, Town River and Weymouth Fore River, all inviting similar industrial developments. When any considerable portion of this extensive water front shall be covered with manufacturing plants, the Metropolitan District will present an industrial area altogether unsurpassed.

All these tidal lands and river and creek fronts thus facing the sea, from Lynn to Weymouth, afford unexampled industrial promise. Factories built thereon could be served by water transportation in front and to a great extent by railroads on the other side. There would be no general necessity for a depth of water sufficient for large steamships. Factories do not require such service at their doors. Their business would be amply provided for by coastwise vessels and lighters. The promoters and managers of New England industries have been too prone in the past to turn their backs upon the signal op-

portunities thus presented by the water front of Boston Bay. Under modern conditions they are beginning to show a higher appreciation of their value. Many manufacturers have found the ample supply of water for condensing purposes in itself a sufficient reason for locating their plants upon these bays and rivers. Added to this is the recognized value of being able to secure coal and foundry and factory supplies by water transportation. This growing appreciation of the value of a water frontage for industrial plants will soon include the obvious opportunity of water competition with the railroads in the bringing in of all raw materials; and then the use of barges, lighters, coasting vessels and probably transfer floats will furnish to factories thus situated the inestimable advantages of being connected with a world-wide system of water transportation.

In this connection the commission wishes to say that municipal efforts on the part of cities and towns to study and develop their own harbors are worthy of the highest commendation. The action of the city of Lynn, for example, in recently appropriating a substantial sum to be devoted to the study, survey and boring tests of its harbor, with a view to future development along lines thus found to be most available, deserves the largest praise. No specific or even general plan for the development of Lynn harbor has been shown to the commission, and it is therefore unable to express any opinion with reference to what is thus contemplated. It has understood, however, that no definite plan is to be determined upon until after the completion of the expert investigation now in progress. The Lynn Board of Trade requested the commission to recommend that the Commonwealth deed to the city of Lynn any flats owned by it within the limits of Lynn harbor, the same to be used by the city in the improvement of the channels and approaches of the harbor and in the development of additional industrial areas. A petition and bill to this effect having now been filed with the Legislature, and hearings having been had thereon before the appropriate legislative committee, the propriety of any recommendation in that regard has become at least doubtful. Generally speaking, it is the judgment of the commission that

the Commonwealth should assist every city or town showing reasonable aspirations for harbor improvements in any way which may be consistent with the retention of such control of its flats by the Commonwealth as will reasonably assure the protection of harbor developments already made. The flats owned by the Commonwealth are of no value to it except in their potential use for commercial and industrial purposes, and in the protection which the ownership of the Commonwealth affords to existing commercial and water-front facilities. Any action on the part of the Commonwealth which will make this potential value an actual one, and at the same time continue its present protection to water fronts already developed, is advisable from every point of view.

The commission has sought to make it clear that the water front of the Metropolitan District affords the highest possible opportunity and promise for commercial and industrial development. It follows as a corollary that the source of such opportunities should be in every way properly safeguarded. Nothing further should be done by the public in the way of takings for park purposes or otherwise which will divert any portion of this great water front from its potential use for commerce and industry. The commission has recommended the permanent reservation of certain areas within Boston harbor for the location of a future system of docks. It is a matter of regret that the most available industrial sites along the water front cannot be similarly reserved. In Germany the industrial development of such areas would be assured by the imposition of certain restrictions, and quite likely also by the purchase of such areas by the municipality or district, with a view to securing their utilization for industrial purposes and no other. While this latter procedure might be quite in line with the policy of the Commonwealth in reserving the flats at East Boston and South Boston, it may be doubted if the State is as yet prepared to go to that extent with relation to these wider areas. To designate them upon the map might have the moral effect of pointing out and impressing upon public attention the importance of utilizing these areas exclusively for the purposes for which they are by every natural advantage

best fitted. But so long as they remain in private hands it will manifestly be very difficult to impose by legislation any restriction which will prevent their owners from making any use or disposition of them which they may desire to make.

As to future dock developments in Boston, Mr. FitzGerald in his report has set forth a plan which provides for all the probable requirements of an indefinite future. It can be carried out pier by pier and dock by dock, as the development of commerce and business shall appear to require. An alternative plan of dock development, including an interesting suggestion for the establishment of an industrial district like the Bush Terminal, will be found in the Part IV. of Mr. Wadsworth's report. In the planning and construction of docks it is important not to lose sight of the distinction between docks for transportation purposes and those for industrial use. It is also constantly necessary to distinguish between foreign and coastwise business. These different uses invite a comparison between the respective advantages of the various sections of the water front. For miscellaneous and coastwise traffic, including the package-freight business, the Atlantic Avenue water front unquestionably affords the best location. A transportation company attempting to do this class of business, with a terminal at East Boston, would be at a distinct disadvantage in competition with the railroads having terminals nearer the center of the city. But the Atlantic Avenue docks are already overcrowded. Their reconstruction may prove to be absolutely necessary. With its newly established street connections, the south side of the harbor may offer the most promising location for additional or larger docks for the coastwise trade. The great volume and increase in this class of commerce should not for a moment be lost sight of. It is constantly growing and is of great value to Boston. The south side of the harbor also possesses great advantages for the passenger business. These would be almost conclusive in its favor if that side of the harbor could be effectively connected by rail with all the trunk lines of railroad entering the city. As a location for docks and terminals for the transaction of export and import business, as well as for

the transshipment of commodities largely coming from or destined for the New England States, East Boston, by reason of its railroad connections, has a pre-eminent advantage over every other part of the city. This has been pointed out clearly by Mr. FitzGerald in his report, and his conclusion in that regard is concurred in by the other members of the commission.

Port Administration.

At a comparatively early day a modern system of port administration for Boston must be formulated. This cannot be done until it shall be determined how the principal harbor terminals are to be owned or controlled. Should the plan of co-operation between the public and the railroads, recommended by this commission, be adopted with reference to the terminals, a similar system of joint control should be extended in its application to dock administration. When the time comes for definite action in that regard there are ample precedents, both in Europe and in this country, which may be examined and followed in whole or in part.

The prevailing custom in Europe is for the public to own and control the docks of leading ports. In this country the docks of the principal ports are owned either by the railroads or the municipal authorities. As a general rule steamship lines do not own their terminals. This is true both in Europe and America. The leading examples of the municipal ownership of harbor terminals in this country are furnished by New York, Philadelphia, Baltimore, New Orleans, Galveston and San Francisco. In Philadelphia, as well as in Boston and Newport News, the railroads have until recently owned and controlled nearly all the important docks. But that city has just decided to spend about $1,000,000 a year in modern wharf construction until the municipality controls one-third of the dock system.

Local Transit.

The final development of an adequate system of rapid transit in and around Boston is vital to the welfare of the Metropolitan District. In view of the extent to which the subject has recently absorbed the public attention, it is perhaps a matter of regret

that with reference to it the commission has been unable to reach any conclusions so definite that they can properly be included in this report. The commission recommends that the study of these important transit problems should be vested in the Boston Transit Commission, with enlarged powers. In the devising and acceptance of every proposed extension of the existing subway system, and in the development of plans for an ultimate system of rapid transit for the Metropolitan District, that commission should be given far wider and more effective jurisdiction and authority than it has heretofore possessed. If its judgment does not approve any plan of proposed development, it should, by appropriate legislation, be put in such a position of authority that the expression of its disapproval will be not only its official privilege but its duty. Contrary to general public opinion in that regard, the Boston Transit Commission has been, with slight exceptions, a constructing board, bound to follow the plans and system determined upon by the Legislature. The members of our Legislature and of its committees, high as their character, personal qualifications and devotion to the public interest are known to be, do not serve for a sufficient period of time to become experts in so complicated and difficult a subject as rapid transit. It is a matter which pre-eminently requires experience and expert knowledge. The railroad companies concerned in these matters have the benefit of the long service of their officers, and are constantly availing themselves of expert assistance. The public should have the corresponding advantage of being represented, in the solution of every transit problem, by a body of trained and experienced men, who have given sufficient study to the subject to enable them to reach sound and wise conclusions.

Metropolitan Highways.

The direction given to this commission to consider the establishment of a system of metropolitan highways appears to have been the result of previous propositions of legislation to the same end. In March, 1904, a bill was reported to the Legislature providing for a commission to report on a "sys-

tematic plan for adequate and convenient thoroughfares in the Metropolitan District, and upon a method of executing such plans if found advisable." In his annual message, Governor Bates urged the creation of such a commission. Owing to the fact that at about the same time an appropriation of $6,000,000 had been made for park purposes, and to a general fear lest the District might become involved in expenses which it was unwilling to consider, no matter how urgent the necessity, this bill was referred to the next General Court. In 1906 a similar bill was prepared by the Governor and Mayor, but the matter then reached no definite form. In 1907 this commission was created, and its instructions provided among other things for a report upon the "advisability of public works in the Metropolitan District tending to the convenience of the people," and the "establishment of a systematic method of internal communication by highways." The commission has given this work its careful attention, with the assistance of its expert, Mr. Shurtleff. Every city and town in the Metropolitan District has been carefully studied, and the improvements deemed essential to meet the instructions of the Legislature, as stated above, have been noted. The commission approves Mr. Shurtleff's suggestions upon the needed highway connections of the district, and recommends that active measures be taken, as later outlined in this report, to remedy the present defective character of the lines of internal communication.

Generally speaking, the radial roads connecting Boston with the country are wide and direct, and perform a very efficient service for the district. This radial system is not, however, being reinforced against larger demands. Additional radial roads are not being gradually created, as might be the case if the municipalities were aware of their importance, or if, at the instance of some central authority, they were obtained as the minor streets are built, one by one or foot by foot. Such a gradual realization of an intelligent scheme calls only for a concerted and rational development, and need involve no added expense to the district.

The circumferential roads connecting one town with another are many in number and are useful to a certain degree; but they

often fail, generally by very small margins, to make connections of the most useful kind. The failure of the existing cross-district (circumferential) roads thus to accommodate through traffic tends to congest the main radial thoroughfares, especially in the vicinity of Boston. Traffic which cannot cross the district for want of connecting roads is obliged to go first to Boston upon the nearest radial thoroughfare and then go out again upon another radial leading to the city or town sought. It is surprising how frequently the lapses in the circumferential highways occur, and yet how readily they might be filled in. Some of these shortcomings need to be made good at once, as, for example, that which prevents a convenient passing from Harvard bridge northward either into the park system or to the common highroads in the northern part of the district. There are many minor lapses which need similar attention. By far the greater number of these can be corrected gradually and without extra expense, provided some intelligent foresight is exercised as to the development of local streets with reference to future needs, and provided some power to undertake such improvements is duly constituted. If, on the other hand, things are allowed to continue as they exist to-day, the time will come when these connections cannot be achieved without almost prohibitive cost. In short, as the road system of the district is a very admirable one, provided the comparatively few defects in it can be corrected, there appears to be no need of establishing a new general system of intercommunication between the various suburbs or between the suburbs and the city. It is a question more of details than of any radical change. But these details are vital to the situation; unless the missing links are made good, it would be fair to say that the circumferential element in the metropolitan highway system comes near being a very bad one.

A Central Authority for Highways desirable.

To expect that this concerted action, so much to be desired, will take place without some organized head to guide it would be a fanciful hope. The officials and the engineers of the municipalities throughout the district realize this fact perfectly.

The commission is led to believe that they would all heartily welcome co-operation with a responsible authority, which would confer with them, offer advice and either be invested with power to execute highway connections or at least be in a position to appeal promptly and effectively to the Legislature for aid. If the public also felt that the whole road scheme of the district were under surveillance, and that an authority existed which would listen to its appeals and from which it might expect advice, the commission believes the body entrusted with such service would become invaluable.

It should also be the duty of the board entrusted with this road work to secure such codification and amendment of the laws relating to the laying out and construction of ways as would render it more practicable and expeditious for the community as a whole to secure desirable roads whenever the vacant land of a district is cut up by private owners with streets to subdivide such land into house lots. At the present time the control of the towns over these land subdivisions is so weak that undesirable roads are being created at the rate of hundreds of miles a year. These just miss, by a small margin, being of service to the public as a whole. Were they under more complete control they could be made of great service without additional cost. Under prevailing methods these inconvenient and ill-advised roads have to be corrected by the public authorities at great expense, and even then they are only sufficient to serve the most primitive needs of the community. It is not too much to demand that the broader rights of the public in these matters shall prevail.

Among the many changes to be desired in the metropolitan highways, as set forth in Mr. Shurtleff's report, the commission points out as pressing and important these larger undertakings: —

1. Connection should be made across Cambridge and Somerville, between the Harvard and Wellington bridges, and between Barry's Corner in Allston and Davis Square in Somerville (see plans opposite pages 194 and 222), to facilitate communication between the northern and southern halves of the district and to take away a burden of unnecessary traffic from the already congested radial thoroughfares of Boston.

2. Provision should be made for additional direct connection between Revere and Lynn for traffic purposes. Also, the present road connecting Lynn, Saugus, Stoneham, Woburn and Lexington should be improved in line and gradient to form a direct and serviceable trunk thoroughfare. (See maps opposite page 256.)

3. A new radial thoroughfare leading from Columbia Road at Mount Vernon Street and thence across the Calf Pasture and along the borders of Dorchester Bay to Neponset bridge should be provided. (See map opposite page 256.)

4. The following changes in the city proper need early attention: a diagonal street connecting Lowell Street with the new Charles River dam should be built in connection with the proposed new route for the elevated railway. Better connection for traffic should be provided between the North Station and the new Cambridge bridge. (See plan opposite page 218.)

The commission was favorably impressed with the project presented at a hearing by a delegation of Newton and Brookline citizens for a parkway to connect the West Roxbury Parkway with the Charles River Reservation at Watertown, via the Putterham Meadows, Hammond's Pond and Cabot Park. The plans shown at this hearing were more carefully prepared than any others of a similar kind presented to the commission, and represented a thorough study of the problem. The commission is of the opinion that this project is an admirable one, and recommends that it be carried into execution as soon as money for additional parkways shall become available. Throughout a portion of its length this pleasureway should also be provided with a traffic road, since it follows in part the line of a needed cross-district thoroughfare. There is good reason for early action in this most desirable project. The owners of the land required or affected by what is proposed have held it intact in a public-spirited way that cannot be expected to continue indefinitely. The cost of the undertaking will be greatly increased by delay. Indeed, the sale of a portion of the land for building lots might so change the general character of the section considered as to make the desired parkway altogether impracticable.

Mr. Shurtleff's report also gives some space to the subject of the appearance of highways, and properly, since to neglect

this aspect of the work would be to forget one of the most important means of rendering metropolitan life agreeable. For the same reason Mr. Shurtleff has discussed at some length the importance of creating and preserving public squares.

The Back Bay district, which is laid out in a rectilinear manner, is at the Fenway cut across by a parkway with meandering roads and water ways. The straight streets are interrupted and the winding roads across the park are few. Real estate owners consider that the Back Bay, already hemmed in by the river and the Albany Railroad, is impeded in its growth by the obstacles that the Fens present. At their request the commission held a hearing on this subject, and advised with a committee of the Boston Society of Architects. A road north and south is not difficult to arrange and would be a public convenience. It would be formed in part of existing roads; starting from somewhere near the Art Museum, in a slight curve, it would continue to or near to the Five Corners at Beacon Street. Although the construction of roads running east and west would not be difficult — for Boylston Street or Westland Avenue could be continued straight across the Fenway — yet these straight lines or causeways would entirely destroy the design of the picturesque parkway, and would practically require a remodeling on urban and architectural lines of the whole district between Westland Avenue and Commonwealth Avenue. The ends to be gained do not justify such a radical remodeling or expense, and the commission has seen no plan of roads which it can recommend.

A New Civic Center.

The metropolitan thoroughfares as they reach the settled portions of the city may naturally be expected to focus at one or more civic centers. The commission has therefore thought that the possibilities for future civic centers should be studied, and a short report by Mr. Peabody and Mr. Shurtleff, expressly addressed to that subject, is added hereto.

In the act of 1859, creating the Public Garden in its present form, it was provided that no building should be erected be-

tween Arlington and Charles streets except for horticultural purposes, provided that nothing contained in the act should "render it unlawful to erect a city hall on the Public Garden." Obviously, therefore, this site for a city hall demands attention, and no site could be more monumental and effective than that which might be obtained on the garden at the end of Commonwealth Avenue. The only cost for this site would be the sacrifice of garden space; the sale of the present city buildings would cover the cost of new buildings on this site. On the other hand, although the restrictions on Commonwealth Avenue will some day cease, and although Arlington Street is already largely devoted to trade, yet this site is at the very entrance of a distinctly residential district. In almost any other site public buildings would make neighboring property more desirable. Here they would injure it, at any rate for the purposes to which it is now devoted. Besides this, there is the general objection always made to giving over to building purposes land in use as a park. Another monumental site for city buildings is to be found at Copley Square, where the city hall might replace the disused Art Museum, and a building for other public offices replace the buildings on the opposite side of the square. As Trinity Church and the Public Library occupy the remaining frontage, a civic center now half furnished with buildings of the highest class would thus be completed in a most satisfactory form. It may be objected to this site that it is not immediately adjacent to present business centers. On the other hand, it is exceptionally well supplied with transit conveniences, and is in a position that is geographically central and of daily increasing importance. There remain sites on the former Boston and Providence railroad property. These are nearer to present business centers, but to obtain a site for monumental effect comparable with those just named enough land must be taken not only for the building sites but for appropriate surroundings, such as a public square, and that in a region which is amply supplied with public open spaces. The commission presents these different studies for consideration and to assist public decision, not regarding it a duty to urge definitely any one site.

One Metropolitan Board for Highways, Parks, Water and Sewerage.

The commission is asked to "recommend the method of executing and paying for these improvements." Immediate execution is not necessary for any of the works suggested, but it is very probable that the work the commission has done in the matter of highways will be largely wasted unless it reaches the hands of some centralized authority. The information gathered should be lodged with some public body, armed with power to hear applications, to press such matters as seem important, to advance those that are good and to criticise those which are bad. There are various ways in which this business may be cared for: —

1. Those in authority in all the different localities might be trusted to study the maps herewith presented and in their local work be guided by them and thus directed towards united action. The different town authorities and the commission unite in believing that the different localities are helpless without organization. To leave the metropolitan highway situation simply to local action will, the commission is confident, lead to no results of metropolitan significance.

2. The county commissioners might undertake the work; but only a small fraction of three of the four counties affected are included in the Metropolitan District; moreover, the several boards could not act effectively in conjunction.

3. It might be entrusted to the Massachusetts Highway Commission; but this is a State commission, whose duties do not relate to the Metropolitan District or to the kind of problems which need solution.

4. The Transit Commission might assume these duties; but it is a local board, almost wholly devoted to subway work for electric-car lines within the city limits. It still has before it several undertakings that must be carried into execution, and, as suggested elsewhere in this report, it should be given wider scope and be asked to study the transit question throughout the Metropolitan District. It was not, however, appointed for, and in the discharge of its duties has no relations with, highway work in the Metropolitan District at large.

5. A new commission might be created to take charge of these matters. There already exist sixty State commissions, and in view of the probable objection to increasing that number this method is not likely to be adopted.

6. Several years ago the water commission and the sewerage board were consolidated into one board of three members, although at the time they were in the midst of the construction of the great water and sewerage systems. The present Metropolitan Water and Sewerage Board has executed important highway work, notably in the Middlesex Fells Reservation, at the Weston Reservoir and at the Wachusett Reservoir, and in the laying and maintenance of water mains and sewers its work also affects the highways. The Metropolitan Park Commission has intimate knowledge of highway problems from the point of view of parks and pleasure drives. It has had extensive experience in the construction of parkways, boulevards and the attendant bridges, dams and conduits, and it has a thoroughly equipped engineering department used to this kind of work. These two commissions are the only boards now in existence whose functions are wholly metropolitan, and which, because the creative activities for which they were organized are in the main accomplished, are now largely devoted to routine maintenance work. To secure a wider view of the field of endeavor, and a more perfect co-ordination of their duties, as well as for purposes of economy, a new consolidation similar to that of the water and sewerage boards might now be effected, thereby constituting a new metropolitan commission, to assume not only the remaining duties of both these boards, but at the same time to take in hand the highway problems of the district.

The accomplishment of a consolidation of metropolitan authority and development in these highway matters would be permanently and generally beneficial. This will be especially true if it carries with it the co-operation of a council composed of the mayors and chairmen of selectmen in the Metropolitan District. This would in itself be enough to insure the accomplishment of many of the improvements which the commission recommends, for it is impossible to conceive that these two bodies could assemble for the purpose of considering the needs of the district without having the folly of longer neglecting these subjects irresistibly

forced upon them. One board would then have in its charge these public improvements throughout the Metropolitan District. It would have the advice, assistance and restraining influence of a council composed of the officials whose duty it is to make up the budgets in all of the thirty-nine cities and towns comprising metropolitan Boston. The meetings, discussions and even the differing opinions of these bodies would without fail bring out ways in which local conditions could be improved, and create better feeling and co-operation among neighboring communities. United action could thus be taken for the benefit of the whole district. The creation of such a commission, to control all metropolitan highways and to take over the present comparatively light administrative work of the Metropolitan Park Commission and the Metropolitan Water and Sewerage Board (including the now practically completed work of the Charles River Basin Commission, which the Metropolitan Park Commission inherits), would retard no public work. It would give increased efficiency and reduced cost, and at the same time establish the proper foundation for the new development of the resources of the district.

Earlier in this report it is recommended that the final studies for the development of a modern terminal system be entrusted to a special commission. It is now further advised that the other recommendations considered in this report be referred to a metropolitan district commission with concentrated authority, created by consolidation as above described. As an adjunct thereto the creation of a metropolitan district council, composed of the responsible executive officials of the various metropolitan communities, is advised.

Achievement.

Throughout its investigations, as well as in the conclusions embodied in this report, the commission has endeavored to avoid the visionary, and has carefully aimed at making its recommendations consistently practical. Large though the undertakings demanded by the public welfare may appear to be, and great their ultimate cost, they involve fewer difficulties than have elsewhere been readily surmounted, and their mag-

nitude is no more to be feared than that of many public improvements which have been unfalteringly achieved by other communities. The examples not only of many European cities, but of not a few on this side of the Atlantic, attest the sound common sense which actuates, and the valuable returns that are derived from, planning largely and wisely for future needs. Nothing more than civic courage and a united purpose guiding popular intelligence are required to meet fully the opportunities which point the way. There are many signs of promise of a new and more progressive era. Confidence in the future will assure its actuality.

BENJAMIN N. JOHNSON.
HENRY B. DAY.
DESMOND FITZGERALD.
ROBERT S. PEABODY.

Railroads and Terminals.

BY GEORGE R. WADSWORTH, ENGINEER.

Boston, Jan. 13, 1909.

Benjamin N. Johnson, Esq., *Chairman, Metropolitan Improvements Commission.*

My Dear Sir: — I have the honor to submit hereto attached my final report in the matter of a study of the present steam railroad systems within the terminal district, with suggestions for improvements in line with what are considered to be the requirements of the best ultimate public service.

This presentation is in accordance with the various points outlined in the fifteen preliminary reports submitted from time to time and variously discussed during the deliberations of your commission.

May I take this occasion to express, through your commission, my cordial appreciation of the assistance rendered by the managements of the several railroad systems, the various public commissions and others in very graciously affording every opportunity to secure what seemed to be necessary data. I wish also to make particular mention of the co-operation of Mr. Frank L. Tibbetts, particularly in connection with the execution of the drawings accompanying the report.

Very respectfully,

G. R. Wadsworth.

I. INTRODUCTION.

General.

The aim of managements of manufacturing enterprises throughout the world is to effect the greatest economies in the cost of production consistent with the standard of quality and price in the manufactured product demanded by the consumer. One of the most obvious steps in line with this aim is effective consolidation, which in the last twenty-five years has been most apparent among those particular interests which "manufacture transportation," — the railroad companies. But

a few years ago, comparatively, each of the eight trunk lines entering Boston represented a separate management, and each maintained its own terminal station for freight and passenger traffic. At the present time consolidation has progressed up to the point where there are four separate managements and three passenger terminals in Boston. Any specific recognition of the present identities of the several steam railroad managements and properties as determining factors is believed to be wholly incompatible with logical suggestions for an ultimate and homogeneous development of the transportation lines within the terminal district.

That a due recognition of these corporate divisions, both physical and operating, must be made at the outset is obvious; but any system which will ultimately represent the highest type of public service, consistent with economy in operation and maintenance, must be developed along the broadest lines throughout the entire horizon. Such a development is not possible under a system requiring more or less strict adherence to the interests of the several railroad corporations involved. A development along the broadest lines, acknowledging the unity of the terminal transportation problem, would result in a property representing the most effective consolidation, and, advisedly, the greatest operating economy. No definite recommendation would be warranted without having at hand comparative estimates, based on designs embodying more or less detail. No detail designs or estimates have been prepared, and the entire investigation has necessarily been in the nature of a preliminary study. A more or less exhaustive study of existing conditions, a conservative forecast of future requirements, an endeavor to maintain, as a basis of reconstruction, in so far as is practicable, well-established features of the present properties, and a firm belief that in the near future a reconstruction of the properties at certain points will be absolutely essential, in order to institute necessary operating economies and meet the demands of contemporary traffic, have led to the suggestions embodied herein.

The text, in connection with the accompanying drawings, outlines the main features for an ultimate development. It is

manifest that the approach to this final state must be gradual, and that the various portions of the work must be segregated and prosecuted in well-defined stages, as traffic conditions may warrant or require. However distant even a possible realization of the many points outlined may seem, it should be borne in mind that only by the adoption of some well-defined plan that is exhaustive in its scope and based on a careful analysis of the present and probable future conditions, can even the preliminary steps for such a development be intelligently carried out. The limited horizon of many past and existing commissions, whose scope of investigation and action is often curtailed by the very statute creating the commission, as well as the limited plane of action which naturally defines the various private corporations and interest, has in the past led to developments which prove ill advised when considered in connection with the entire problem.

No attempt has been made toward the specific determination of the individual needs of the various communities within the terminal district as a basis for the development suggested; such a course would in a measure acknowledge the finality of present conditions. The system proposed provides for a flexibility of operation with but few limitations. Such a system will not only meet requirements of the immediate future, but its quality of "flexibility" provides for conditions, at present indeterminate, which may arise in the future.

The development suggested is in line with a firm belief in the future growth of the port. To those in whom this belief is lacking, whose forecast of the commerce of the port is a sad commentary on the business acumen of Boston merchants, this report is not dedicated.

Growth since 1850.

The attached diagrams, Plate V., have been prepared for the purpose of showing the comparative rate of growth in various characteristics of several North Atlantic ports, viz., Boston, New York, Philadelphia and Baltimore. These statistics were compiled from letters and reports received from the United States Census Bureau.

Population.

Per Cent. of Increase, based on Ten-year Periods.

	Average, 1850 to 1900.	1895–1900.	1900–1905.
Boston (Metropolitan Park District),	37	30	14
New York,	42	37	32
Philadelphia,	32	24	19
Baltimore,	27	27	15

Tonnage of Vessels entered and cleared.

Per Cent. of Increase, based on Five-year Periods.

	Average, 1855 to 1900.	1895–1900.	1900–1905.
Boston,	16	32	14
New York,	23	21	18
Philadelphia,	40	36	—2
Baltimore,	59	102	—28

Value of Merchandise — Imports.

Per Cent. of Increase, based on Five-year Periods.

	Average, 1855 to 1900.	1895–1900.	1900–1905.
Boston,	14	8	40
New York,	17	13	26
Philadelphia,	25	6	17
Baltimore,	23	56	12

Value of Merchandise — Exports.

Per Cent. of Increase, based on Five-year Periods.

	Average, 1855 to 1900.	1895–1900.	1900–1905.
Boston,	32	31	—22
New York,	27	44	1
Philadelphia,	34	124	—17
Baltimore,	44	87	—17

Bank Clearings.

Data are incomplete as regards Philadelphia and Baltimore, being available only from 1890 and 1885 respectively. From 1855 to 1900 the average rate of increase based on five-year periods was for Boston 25 per cent. and for New York 44 per cent.

It is, perhaps, obvious that no direct inference can be drawn from the data illustrated by the diagrams without a more careful analysis of the actual condition prevailing at the various ports throughout the period under consideration. The diagrams simply present data that is readily available in a form where direct comparison as to several characteristics of the ports is possible. As an interesting fact, however, it may be noted that as regards the tonnage of vessels entered and cleared, as well as the value of merchandise imports, the average rate of increase since 1850 is less for Boston than for the other three ports.

II. FREIGHT TRAFFIC.

Tonnage Data.

The tonnage data embodied in the appended tables I., II., III., IV. and V. are submitted as a matter of interest, although having no direct bearing on the physical development suggested.

Table No. I. shows the total gross tonnage handled by the three trunk line systems at the port of Boston for the year 1907. The small amount of export and import tonnage handled by the New Haven road will be noted.

Table No. II. shows the various percentages of the total gross port tonnage for the year 1907, handled at the several freight yards for local delivery, and to the docks and wharves for transshipment. Tonnage for points on the Union Freight Railroad is included under Minot Street and Congress Street, — the local delivery stations of the connecting lines.

Table No. III. shows the percentage of import tonnage, outbound over the several trunk lines, destined to and beyond Buffalo, the trunk lines' western terminal, for the fiscal year ending June 30, 1907. The balance of import tonnage is consumed locally, or distributed between the port of entry and Buffalo.

Table No. IV. shows the relative amounts of export tonnage received via the several trunk lines monthly for the fiscal year ending June 30, 1908.

Table No. V. shows various percentages of export and import tonnage handled by each trunk line system compared with total gross tonnage of the port, total export tonnage, total import tonnage, total line export and import tonnage, for the year 1907.

Main Features in Present System of Local Freight Distribution.

1. Present Local Delivery Stations.

Serving the terminal district of Boston for the receipt and delivery of commodities are 12 principal local freight stations, as follows: —

	Local Name.	Location.
Boston & Maine,	Minot Street,	Boston.
	East Cambridge,	Cambridge.
	Mystic Wharf,	Charlestown.
	Warren Bridge,	Boston.
	Warren Bridge,	Charlestown.
	Rutherford Avenue,	Charlestown.
Boston & Albany,	Kneeland Street,	Boston.
	Huntington Avenue,	Boston.
	East Cambridge,	Cambridge.
	East Boston,	East Boston.
New Haven,	Congress Street,	South Boston.
	Massachusetts Avenue,	Boston.

2. Boston & Maine System.

The present freight terminal receiving yards of the several divisions of the Boston & Maine Railroad are located in Somerville, the yards being entirely separate, except for Eastern and Western division traffic, where one yard is used jointly.

From these separate receiving yards, local freight moves forward to the corresponding local delivery station much as if the several divisions were in reality separate railroads. As a

matter of fact, in the present system of operation of the Boston & Maine freight terminal properties, the four divisions maintain their identity largely to the same extent as before consolidation, the only coalition being one of management, and except for the convenience of dealing with one management, the public is forced to accept the rigid conditions to-day much the same as under the old régime.

On account of this lack of effective consolidation and unification of the terminal properties, which should logically follow the amalgamation of managements, the cost of terminal operation is unwarrantably high, and some of the real benefits to a terminal community which should follow a consolidation of managements have been practically nil.

3. Boston & Albany System.

At present Boston & Albany freight runs terminate at Beacon Park yard, where the cars are classified for Huntington Avenue and Kneeland Street local delivery yards in Boston, for points on the Grand Junction Railroad and for the East Boston export terminal. Beacon Park yard, although of an inferior design at present, is advantageously located, and will in time be rebuilt and remodeled into a thoroughly adequate terminal freight yard.

4. Grand Junction Railroad.

Built about half a century ago; crossing all avenues of approach into Boston for 180 degrees around the west, north and east, within 3 miles of the city proper; cutting at grade all railroad lines from the north; owned and operated by one railroad corporation through territory logically and geographically belonging to another system; to-day that portion of the Grand Junction Railroad between Massachusetts Avenue in Cambridge and Broadway in Somerville, a distance of 2½ miles, as a result of development along lines of least resistance, crosses at grade eight public thoroughfares, nine electric street railway tracks, eight main line passenger tracks and nine side or switching tracks.

Between the Charles River and Somerville Avenue, a distance of 2 miles, there are in Cambridge forty-four separate manufacturing concerns, two only of which are also served by

the Boston & Maine Railroad. No other section of railroad within the limits of Greater Boston serves anything approaching this number of industries in a corresponding distance. Within this same section there are twenty-two streets, terminating at the right of way of the railroad.

The Grand Junction Railroad, by reason of its location, is virtually an inner belt line, connecting all trunk lines entering from the north and west, and becomes an important feature in establishing the desired flexibility of operation in connection with local freight distribution.

5. New Haven System.

The yards at Readville, for the Providence and Midland division traffic, serve for the receiving, storage and partial classification of cars for Boston delivery. From this point cars move forward to local delivery points on the two divisions between Readville and Boston, and to the South Boston terminal of the system. The majority of movements are through runs direct to South Boston, via the Midland division from Readville.

The yards at Braintree serve the Plymouth division of the system for storage and receiving purposes; in general, however, freight runs are direct to South Boston.

6. Union Freight Railroad.

The road is located throughout its entire length of about 2¼ miles in public thoroughfares. It extends from a set of transfer tracks on railroad property at the Minot Street local delivery freight yard of the Boston & Maine Railroad west of North Station, through Lowell Street, Causeway Street, Commercial Street and Atlantic Avenue to Kneeland Street, where it again enters railroad property, connecting with a set of transfer tracks of the New Haven system adjoining the easterly side of the Kneeland Street yard of the Boston & Albany railroad.

This line is the only direct, all-rail connection in Boston between lines entering the terminal from the north and from the south, the Boston & Maine and the New Haven systems. It is operated as an independent railroad, although acknowledged

New Haven property, its terminals being the two sets of transfer tracks above mentioned, where delivery is made to the connecting roads. Its general offices, engine house and a local delivery yard of limited capacity, only about 15 cars, are located on property of the railroad opposite Commercial Wharf, on Atlantic Avenue, along the southerly side of Commercial Wharf (Street). The company also owns the property formerly of the Boston Gas Light Company between Causeway Street and the Charles River, west of City Wharf.

There are at present eighteen side tracks or spurs on the piers or water-front property, and also two spur tracks entering the market on Atlantic Avenue, between Clinton and South Market streets.

The physical condition of the road is much the same as it was twenty-five years ago, while the conditions limiting its operation are more exacting and its effective capacity consequently less. Furthermore, the effective operating capacity of this important link in the transportation system of the terminal will continue to diminish unless some direct measures are adopted toward lessening the increasing limitations to its operation.

The primary demands of the city thoroughfares for the accommodation of vehicular and pedestrian traffic must be recognized. In addition to these two classes of traffic, the thoroughfares contiguous to the water front between the North and South stations, in the main eighty feet wide, comprise in their sections surface-car tracks and an elevated railway structure, as well as the tracks of the Union Freight Railroad.

The only traffic regulations apply to the freight traffic, whereby practically all movements, except of perishable goods, are restricted to the night hours, when there is little or no ordinary street traffic. Notwithstanding this regulation in the attempt to provide for a great amount of teaming, the general condition of the street pavements is so wretched that the bulk of the teamed tonnage between the north and south sides follows the narrower streets and more irregular routes through the congested market district, rather than the more direct route via Atlantic Avenue and Commercial Street.

The road serves for the movement in car-load lots, between

the New Haven and the Boston & Maine systems, of freight originating on one system and destined for points on the other system, located near the city. This class of through movement involves rather less than an average of 200 cars for twenty-four hours. Freight in less than car-load lots is teamed across the city between the freight terminals of the two roads.

If for any cause traffic on the Union Freight Railroad is seriously interrupted, so that even night movements are impossible, tonnage in car-load lots as well is teamed through the city.

Tonnage from northern to southern New England points, and *vice versa,* as a rule is detoured around the city via the Fitchburg and Lowell branches, Taunton division, New Haven road, which is virtually an outer connecting line. The road also makes direct deliveries to the piers on the water front of goods for transshipment in coastwise vessels, as well as a large amount of produce for the Boston markets.

The relation of this line to the present rigid system of local freight distribution is somewhat limited. Under the district system proposed it will become far more important. For the class of through movements described, the road is at present the only all-rail avenue for through routing.

7. Teaming between Local Delivery Stations and Consignee.

As a rule, the terminal rate for Boston delivery implies delivery to the consignee at the local freight yard terminating the trunk line on which the tonnage enters. Any variation of this system, requiring the switching of cars to another local delivery yard, is subject to an additional charge for switching. Confronted with these rigid requirements, merchants team their goods in many instances entirely across the city. Were it possible for every merchant to secure service at the local freight station nearest to his place of business, the aggregate saving in ton mileage for commodities hauled in teams through or across the city would have reached in 1907 the quite considerable figure of about 6,000,000 ton miles.

Tables VI. and VII., appended, show the amount of teaming of this class actually performed during 1907.

8. Teaming for Purpose of Transfer.

The companies handling a large amount of team tonnage, forwarding companies, are the recognized agents of the railroad companies in the transportation of commodities (as a rule in less than car-load lots) across or through the city, from one road to another. The charge for this teaming, from 4 to 10 cents per ton mile, depending on the class of goods, is absorbed in the through tariff.

A very large proportion of the teamed tonnage handled by the forwarding companies is freight originating on the Boston & Maine system, or connecting lines, in less than car-load lots, for points on the New Haven system, within the radius of territory served from Boston as a reclassification center, and *vice versa.* Goods in car-load lots, however, when like movement is necessary, move *by night* via the Union Freight line, at a charge of 20 cents per ton (about 10 cents per ton mile), with a minimum charge of $3 per car. When, from one cause or another, traffic on the Union Freight Railroad is tied up, the forwarding companies are often called upon to carry commodities in car-load lots originally destined to move via the Union Freight line. The forwarding companies handle practically no teamed tonnage for the merchants of Boston. The various firms having large annual tonnages do their own teaming, or contract the same to jobbers, as is usually the case with the smaller shippers.

Another and unusual class of transfers of goods in less than car-load lots is performed by the forwarding companies among and within the several freight stations of the Boston & Maine terminal system. This class of transfers, in accordance with the best modern practice, is effected by means of a series of transfer platforms, the goods being trucked from the through car direct into the car for local destination. The present arrangement of the yards and freight houses at the Boston & Maine terminal is such, from the very manner of their growth, that a system of transfer platforms, capable of efficient and economic operation, is impossible, except as the same may be designed and instituted in connection with the general remodeling of the terminal as a whole. Hence it is necessary to

have the goods teamed between the several freight houses, at charges likewise absorbed in the through rate, and much in excess of the actual cost of effecting the same service in the usual way.

This service is performed by means of teams somewhat as follows: —

A car from the west entering over the Southern Division, with freight for Belmont, Winchester, Wakefield and Lynn, is placed at the East Cambridge yard, the bulk freight terminal delivery yard of this division. The car is then unloaded, and the goods transferred by teams to the assigned space in the proper freight house, to insure loading in the Belmont, Winchester, Wakefield or Lynn cars. That is, in the above instance, the team must stop at four separate points to deliver the four packages of goods, which are then trucked into the proper car for destination.

This function is usually performed by the railroad company itself by means of transfer platforms, where goods are trucked direct from the through car into the local car for destination. The above archaic method of transfer is expensive, and the cost to the railroad company is absorbed in the through rate, and carried by the goods.

9. *Facilities for Interchange.*

The interchange points between the several railroads under the present system of operation are as follows: —

	Boston & Maine.	Boston & Albany.	New Haven.
Boston & Maine, . .	- -	Somerville via Fitchburg Division.	Minot Street via Union Freight Railroad.
Boston & Albany, . .	Somerville via Grand Junction Railroad.	- -	Kneeland Street.
New Haven, . . .	Kneeland Street via Union Freight Railroad.	Kneeland Street, .	- -

Interchange between the Boston & Maine and the Boston & Albany systems, and between the Boston & Albany and the

New Haven, are comparatively infrequent, and then usually for through freight routing, switching charges being exacted in all cases. Those between the Boston & Maine and the New Haven systems, via the Union Freight Railroad, are also for purposes of through routing.

These transfers or interchanges are distinctly a part of the through routing, all charges being absorbed, and seldom apply to freight for local delivery. The consignee receives his goods at the local freight terminus of the trunk line, enjoying the haul on his shipment, this being Boston delivery in the terminal rate.

Various Systems to be considered.

1. The General Proposition of a Belt Line.

The purpose of a belt line railroad may be one, or all of several, as follows: —

First, to detour traffic around a densely populated district.

Second, to provide flexibility of operation in the interchange of traffic among and between the various lines intersected.

Third, to open up new territory for industrial activity.

The first case is often applicable to inland cities that develop rapidly with trunk-line traffic. As the community grows, traffic through its confines, via the original and direct route, becomes congested, and a belt line for detouring through traffic around the community becomes an economic necessity.

If constructed solely for the purpose of diverting traffic of one trunk line, the belt road would have no physical connections with the tracks of other lines crossed. On the other hand, designed for joint use of all entering lines, the belt line would be provided with connections to and from the several trunk lines entering the city.

The belt railroad would then be available for an avenue of interchange. In fact, these two purposes of a belt line are closely related, and with the gradual loss in identity of the trunk lines as they are absorbed into a system, the belt line becomes a connecting link to provide for the greatest flexibility in traffic movements in the vicinity of a large community.

The third use, rather than a direct purpose, must be con-

sidered entirely subordinate to the first and second uses. A route laid down to serve best the needs of traffic diversion and interchange, would hardly touch those localities best adapted for manufacturing purposes.

On the other hand, a belt route designed primarily to open up property for manufacturing or commercial purposes would subordinate the more important requirements for traffic movements.

2. Impracticability of a Belt Line for Boston.

A. As a Means of Detour. — By reason of its location as a tide-water terminal, Boston does not lie in the path of any great amount of all-rail through traffic. Through business is to a great extent strictly port tonnage, for transshipment in vessels. The all-rail through business consists of traffic in commodities to northern and southern New England points, from manufacturing cities within a radius of about 15 miles of Boston, where the obvious routing on a minimum mileage basis is through Boston to destination.

This class of shipments, as, for example, from Brockton to Lynn, especially when in less than car-load lots, is necessarily subject to more or less delay in switching and rehandling in Boston from one railroad system to another. In this and similar instances a belt line railroad around Boston would provide a direct route for through and way freight movements, at the expense, however, of considerable additional mileage.

This class of movements, a very small one in comparison with the total tonnage of the port, comprises all the traffic which might with possible advantage avail itself of a belt route for purposes of detour. Tonnage for northern and southern New England points, originating beyond the 15-mile radius from Boston, may be detoured by existing lines and connections, with the exception of traffic on the Plymouth division of the New Haven, and on the Eastern division of the Boston & Maine.

An extension and improvement of the transfer and interchange facilities existing in Boston to-day would provide for expeditious traffic movements of this sort quite as well as would a belt route, and much less mileage would be required.

B. To provide Freedom of Interchange. — To provide

flexibility of operation in the shipment and receipt of tonnage, both for local delivery and for transshipment in vessels, a belt-line railroad around Boston would fulfill all requirements.

A thoroughly flexible and economical system for the intimate interchange of tonnage among and between the eight entering trunk lines, the several local delivery stations and yards, and the various docks and wharves within the terminal district, will, so far as transportation facilities are concerned, afford great benefit to the commerce of the port.

A properly designed belt-line road would provide this flexibility, as traffic would be diverted at the junction of the belt line with any trunk line or branch to any other main line or branch, and so to the desired local freight yard or dock. This procedure would, however, entail additional mileage, as well as necessitate an additional classification of freight units at each junction point, assuming that local delivery facilities are maintained in the terminal district essentially as at present.

This flexibility of movement and facility of interchange can, however, be accomplished by rebuilding and augmenting certain features of the existing freight terminals as they are to-day. This interchange, performed at or near destination, will obviously be more direct and save in mileage over that effected by movements via a belt route.

C. To stimulate Industrial Activity. — Regarding the functions of a belt-line railroad as a means of transportation to sites for prospective industries and centers of commercial and manufacturing activity, promoters of large industrial enterprises to-day, in seeking a suitable site for their activities, will, among others, consider the following points: —

The local laws regulating the production of the commodity.

The labor market.

The cost of plant construction.

The cost of land for initial and ultimate development.

The housing of operatives.

The cost of raw materials laid down at the site.

The transportation facilities to market the finished product.

Water supply.

The inducements under the first three items above will vary but little, if any, as applied to any locality within 20 miles of

Boston, and need not be considered. For the more ready appreciation of the other considerations it is desirable to consider some specific route for a belt-line railroad.

Several belt-line projects have been advanced, that having the greatest scope being the one proposed by Mr. H. C. Long, the approximate route being as follows: —

Beginning at Lynn, the line crosses the towns of Lynn, Saugus, Wakefield, Woburn, Lexington, Waltham, Weston, Wellesley, Needham, Dover, Westwood, Norwood, Canton, Randolph and Braintree.

The proposed route, over 50 miles long, cuts seventeen railroad lines, crosses over one hundred and fifty public thoroughfares and encounters about twenty-five thickly settled towns or districts.

The tone of the community for high-class residential purposes is well established, and equally well known, in the towns of Wakefield, Woburn, Lexington, Wellesley and Needham, and only to a lesser degree in all of the other towns crossed. The standard of land values established on the basis of a high-class residential district is hardly compatible with cheap land for manufacturing sites, or with house sites for wage-earners. Owners are looking to see those values appreciate, as they surely will with improved roads, greatly improved and increased suburban traffic facilities (which will follow the electrification of the present steam lines) and the constantly increasing ground rents near Boston proper.

Even were the land values for certain stretches along the proposed route consistent with allowable ground costs for industrial purposes, the acknowledged obstructive attitude of residents in the vicinity would be practically insurmountable.

Sooner or later conditions may force the establishment of one or more communities of wage-earners in the outlying districts to relieve the localities at present occupied by this class of population. This step will be a problem in itself, however, and will result merely in one or more additional communities of operatives, and not in a lot of haphazard scattering settlements. To be well governed, and forced to live up to a certain sanitary standard, this class of the population, largely foreign, must be centralized.

The transportation facilities afforded industries located along the proposed belt line would be ample for rail shipments. The belt line would make possible a direct movement via any main line or branch. For shipment by water, however, goods must first be hauled from 15 to 30 miles by rail, — a distinct disadvantage over a water-front location, where shipment may be made direct either by rail or by water.

D. Summary. — For purposes of detour, as regards traffic from localities within 15 miles of Boston destined to points in northern and southern New England, certain revisions and extensions to existing terminal features in Boston will provide for the expeditious and economical transfer of through freight.

To provide flexibility in the interchange of traffic among and between the entering trunk lines, the local freight stations and the water front, revisions and extensions to existing terminal features will likewise bring about this result, and perform the function at a great saving in mileage over a belt line.

For the purpose of stimulating industrial activity by offering advantageous sites for manufacturing purposes, a belt line traversing territory within a radius of 20 miles of Boston would offer no inducements.

Thirty-five years ago possibly a belt-line proposition might have been prosecuted on a sound financial basis. To-day there is no valid reason for its construction, even were the same subject to sound finance. The same results as to flexibility in traffic movements which a belt line would provide can be accomplished more advantageously, and at an infinitely less cost, in another and more direct manner.

The sites of future industries, which shall represent the greatest efficiency in production, must, as a rule, be on the water front, at the foci of the arteries of transportation. There are millions of square feet of flats both at East Boston and at South Boston admirably adapted to this use, — sites near a good labor market, where the housing of operatives is in well-established and neighboring localities.

The mere fact that belt-line routes are being operated successfully at other cities throughout the country is in itself no criterion as applied to Boston.

3. Abstract of Report by William J. Wilgus on a System proposed for the Port of New York.

In September, 1908, the Amsterdam Corporation of New York City submitted to the Public Service Commission, First District, State of New York, a report by William J. Wilgus, covering "An Improved Method of Freight Distribution in the City and Port of New York."

The salient features of the proposition are as follows: —

It is proposed to divert all freight destined for Manhattan, from every entering trunk line, into one or more central receiving and classification yards. At these yards every ton of freight will be unloaded and again loaded into small, 10-ton cars of standard gauge. These small units will then proceed by electric power through one or more new tunnels, under the North and East rivers, into a four-track subway, skirting practically the entire river front of Manhattan.

From this proposed four-track, subsurface marginal railroad, through the streets, will lead single or double track tunnels located in the present vault areas under the sidewalks, from which goods will be received direct to the basement or sub-basement floors of the store or warehouse. From this marginal railroad tracks will also lead to every pier and wharf.

By reason of this comparatively small capacity and size of the distributing carrier unit adopted, — viz., 10-ton capacity cars, — curves of a very small radius and grades up to 10 per cent. can be satisfactorily negotiated.

This will permit of the turning of sharp corners at street intersections, and also permit of the ascent from the level of the marginal railroad to the level of the docks in a comparatively short distance.

The advantages enumerated are as follows: —

First. — The realization of a flexible system of local freight distribution, wherein tonnage entering the port over any trunk line may be forwarded direct by rail to any warehouse, factory, store or dock.

Second. — The relief of the intensity of street vehicular traffic by reason of eliminating all the trucking now necessary

between the local delivery yard or dock and the consignee or shipper.

Third. — Release of the sidewalks to their primary purpose for pedestrian traffic by providing for the receipt and shipment of goods direct to the basement or subbasement floor.

Fourth. — The release of the quite considerable areas on or near the water front now necessary for the storage and handling of cars prior or subsequent to their actual unloading or loading.

Fifth. — Provision for rail service to all piers on the water front of Manhattan.

The objections enumerated are as follows: —

First. — The vault areas under the sidewalks, now enjoyed by abutting owners, would necessarily be utilized by the subsurface delivery tracks, and present uses discontinued.

Second. — The adoption of the scheme would virtually compel its use by all interests contiguous to the delivery tracks, as all vault privileges would be forfeited.

Third. — The necessity of breaking bulk on every car of freight at the general receiving and classification yards.

Fourth. — The rendering useless and practically valueless of a large amount of present railroad assets, which have been gradually developed to meet conditions as they exist.

Fifth. — The enormous expense of the undertaking.

The proposition is of too recent an utterance to warrant any final judgment in the premises. A refined final analysis of the entire scheme would alone warrant a definite opinion.

The proposition is along the general lines of the Chicago tunnel system of freight distribution, which is now being operated in a more or less ineffectual and unsatisfactory manner within the confines of that inland city. The development proposed for New York, however, is along far more comprehensive lines, and its realization would, physically, provide an enduring system of the utmost flexibility.

The rather remote possibility of adopting a similar system for Boston need not receive serious consideration at this time. Should this course prove to be an economical possibility in years to come, its installation as a new and far more intimate system for the distribution of local city freight may proceed as an extension to the development suggested herein.

4. *The General Proposition of a Clearing Yard.*

The means generally employed to effect a coalition of properties that have been developed along lines of independence and competition, in order to effect a greater or lesser degree of flexibility in the matter of local freight distribution, is the installation of a clearing yard.

In its broadest conception this feature is located at the focus of all entering trunk lines, where cars are classified or sorted and forwarded to the desired points for local delivery.

This ideal application is seldom possible. With trunk lines entering a distributing center from all points of the compass, two or more clearing yards may be desirable, and the system is subject to certain operating limitations which force the retention of some features of rigidity.

As it is rarely possible to install a clearing yard at the focus of entering trunk lines as they exist, new connections from the several trunk lines to the clearing yard are often necessary. When adequate space is available, it is desirable to install and operate in connection with the clearing yard a terminal freight yard, likewise for the joint use of entering trunk lines, for the receipt of inbound trains prior to sorting the cars for local distribution, for making up outbound trains after cars pass from the several local delivery stations through the clearing yard, for the general storing of cars, and for the care and housing of engines, both road and switching.

When local conditions preclude the practicability of establishing a joint terminal freight yard contiguous to the clearing yard, separate terminal yards must be maintained, each serving one or more entering lines.

5. *A Clearing Yard applied to Boston.*

Even were such a course desirable or necessary, it is manifestly impracticable to install a single clearing yard to serve directly all trunk lines entering the port. Such a measure would require a belt line road practically around the city. The Grand Junction Railroad, however, is an inner belt line, connecting all roads entering from the north and west, while the

Union Freight Railroad connects the northern and western with the southern systems.

By interposing a clearing yard, with the necessary connections and allied features, along the Grand Junction Railroad, on property of the Boston & Maine Railroad in Somerville, the four divisions of the latter system are effectively combined in the matter of local freight distribution. The Boston & Albany road also enters the clearing yard direct, via its Grand Junction branch. By increasing the effective capacity of the Union Freight Railroad, and, further, by the installation of a system of car floats to ply between Mystic Wharf and South Boston, to augment the function of the Union Freight road in its transfer of tonnage across the city, the New Haven system is also served by the clearing yard.

Certain classes of movements, from the trunk line to the local delivery yard and *vice versa* would be direct, as at present. The clearing yard established as above suggested, however, would with some limitations provide that quality of operating flexibility which is essential to the homogeneous development of the local freight distributing system.

Main Features of Proposed Development.

1. Flexibility of Operation.

The system proposed for the distribution of local tonnage and tonnage for transshipment is eminently in line with the general needs of the commerce of the port for a system of distribution which shall eliminate the present rigid features, and place at the command of producers, shippers and merchants a distributing system which shall possess flexible qualities, whereby with nearly equal facility goods may be received and delivered, as a rule, at the nearest local freight station, and forwarded by any trunk line desired.

Plate IV. appended gives a diagrammatic illustration of the possibilities of freight movements within the terminal district under the proposed system.

2. District System of Local Delivery.

Revisions of the railroad properties to facilitate the placing of cars, by rail, at the station nearest the place of business of

the consignee or shipper, would not only effect an annual saving in teaming of about 6,000,000 ton miles, but would relieve the city thoroughfares of a considerable proportion of team traffic, and at the particular points where to-day its intensity is the greatest. That is, by dividing the city into zones and districts, each district to be served so far as possible by its prescribed local freight station, the boundaries of the districts would quite properly lie along the thoroughfares in the business center of the city.

The appended statistics, Table VI., give facts compiled from data furnished by the traffic departments of the several railroad companies relative to the present ton mileage teamed to and from the eight most important freight stations in Boston.

To curtail as much as possible the rather onerous work of compilation, only those patrons handling a total minimum annual tonnage of 500 tons were considered. On this basis about 57 per cent. of the total teamed tonnage was figured in the results, and it is safe to assume that results including the total teamed tonnage could be prorated on a like basis, with sufficient accuracy.

In all cases the actual distance from point of delivery at the freight station to the business or factory address of the consignee was employed in figuring the actual mileage, the mileage beyond district limits being the difference between the actual haul and the distance to the nearest freight station.

It is perhaps obvious that no direct deduction should be drawn from ton miles saved, and the average cost of teaming per ton mile, to arrive at the sum actually saved. This procedure would merit just criticism, as the greater cost is at either end of the haul, at point of handling, — loading and unloading. The cost of actual handling for an average haul of 1 mile, once the load is placed, is probably about one-half the aggregate average cost.

The statistics show, however, — applying the results obtained for the 57 per cent. of teamed tonnage actually figured pro rata to the total teamed tonnage, — that about 51 per cent. of the present total ton mileage on goods teamed through Boston thoroughfares, between freight station and factory or place of business, would be eliminated were the district system of

delivery put into effect. The tabulated results do not include teaming performed by the forwarding companies as agents for the railroads, nor, obviously, the teaming among and between the various storage warehouses, wholesale houses, factories and retail stores within the city.

Table No. VII. covers only the four freight stations nearest the commercial center of the city, viz., Minot Street, Warren bridge, Congress Street and Kneeland Street.

This saving in teaming must obviously be considered disadvantageous if it is to be obtained at the expense of deliveries. There is little doubt, however, that under efficient management deliveries can be advanced under the proposed system. There are certain manifest limitations due to local conditions which prevent the strict application of this system. It can, however, be applied to the greater portion of the tonnage entering and leaving the city, except that handled in less than car-load lots.

Necessary Extensions and Revisions of Present Properties.

1. Improvements for the Grand Junction Railroad.

A. Charles River Crossing. — The improvement of the Cottage Farm bridge when the same is replaced by a permanent structure should be studied in conjunction with the construction of a permanent railroad bridge just below, and *vice versa.* Both existing structures are of a more or less temporary construction of piles and timber, and in due course will be replaced by permanent structures of masonry and steel.

Without an unsafe contraction of the water way, it will be possible partially to fill the area between the two bridges and develop a park, sloping down easterly from the higher grade of the Cottage Farm bridge to the grade of the railroad bridge, some 20 feet below, and offering a possible treatment for the head of the Charles River basin.

B. Separation of Grades at Crossings of Passenger Tracks. — Under existing conditions the Grand Junction Railroad through Somerville crosses at grade eight main passenger tracks of the Boston & Maine system, as follows: —

Four tracks, Fitchburg division, at Somerville Avenue crossing.

Four tracks, Eastern and Western divisions, just south of East Somerville station.

On account of the comparative infrequency of movements on the Grand Junction Railroad there is little immediate need of grade separation at these points. These improvements should, however, be effected in connection with the general development.

(*a*) Alignment. — It is essential that the road be relocated across the northerly end of the McLean Asylum property of the Boston & Maine Railroad in order that it may pass through the proposed clearing yard, and at the same time be removed as a barrier to the best development of the terminal property. The present right of way of the road through Boston & Maine territory is a serious obstacle to any development of the McLean Asylum parcel.

An extension of that tangent of the Grand Junction road, between Harvard Street and Medford Street, Cambridge, would cut the McLean Asylum parcel at the proper point for developing the proposed clearing yard along its northerly limits. This course would, however, cross the "North" packing house properties, and is considered impracticable on this account. A route embodying about 150 degrees of curvature, but avoiding the "North" properties, is suggested, and is indicated on Plate II., appended.

(*b*) Grades. — Based on electric operation, grades of 2 per cent. may safely be adopted for passenger traffic. It will therefore usually be simpler to raise passenger tracks in order to effect grade separations rather than depress the Grand Junction road where lighter grades must be adopted for freight traffic. The existing grade of the Fitchburg Division tracks in the vicinity of Somerville Avenue has been virtually fixed by the recent decision of the Railroad Commission in the matter of grade-crossing eliminations through Somerville, which establishes a limiting elevation at the point of crossing of the Grand Junction road. The obvious solution seems to be the depression of the Grand Junction Railroad to pass under the Fitchburg division tracks, and the elevation of the Eastern and Western divisions tracks (just south of East Somerville station).

The present maximum operating grade on the Grand Junction Railroad is about .65 of 1 per cent. The desirability of establishing that portion of the Grand Junction Railroad across

the northerly end of the McLean Asylum parcel (where it becomes virtually a part of the proposed clearing yard) at elevation +12, about the elevation of extreme high water, makes it impossible to maintain this limiting grade of .65 per cent. A grade of 1 per cent. must be adopted from the limiting point under the Fitchburg tracks at about elevation 0 in order to ascend to grade 12 at the westerly end of the proposed clearing yard.

Beginning the depression at a point on the present line a short distance south of Cambridge Street, the road would descend on a 1 per cent. grade, crossing under Cambridge Street and Medford Street to the limiting point, elevation 0, under the Fitchburg division tracks. The road would thence ascend on a 1 per cent. grade, crossing under Somerville Avenue and the Southern Division tracks, to grade +12 proposed for the clearing yard; thence at this grade across the McLean Asylum parcel to a point under the Eastern and Western divisions tracks, elevated at this point to grade 32. From this point the road would swing northerly on railroad property and ascend to an intersection with the present line and grade at the Washington Street overhead bridge, just south of East Somerville station.

The Western and Eastern divisions main tracks would begin to ascend southerly at the Washington Street overhead bridge, and on a 2 per cent. grade would reach elevation 32 at the proposed point of undercrossing of the Grand Junction Railroad, the run out to present grade being accomplished at a point about 800 feet further south.

The suggestions outlined above are indicated on the drawings appended, plates II. and VI.

C. Double Tracking. — Incorporated in the new river crossing at Cottage Farm, double track will of course be installed. The two short existing single track stretches across the Boston & Maine tracks in Somerville will be avoided by the adoption of the change in location through the proposed clearing yard, to the northerly side of the McLean parcel, as described. The remaining single track portion of the road is that stretch adjacent to and easterly and southerly from the Eastern Division main line from Washington Street, Somerville, to Broadway, Chelsea, — a distance of about 3 miles. Throughout this

section the passenger stations at Everett, East Everett and Chelsea are all to the north of the tracks. The span of the overhead bridge carrying Broadway across the tracks at Everett station is ample for an additional track. The two overhead structures carrying Washington Avenue and Broadway over the tracks just east of Chelsea station are old both in substructure and superstructure, and of spans sufficient for three tracks only. The character of such additional right of way as might be necessary for the second track is largely unimproved, or encumbered by the cheaper class of dwellings.

2. Receiving Yards.

As has been mentioned above, the present receiving and storage yards of the Boston & Albany and the New Haven roads are well located and adequate for future development.

The existing Boston & Maine terminal yards, however, are entirely inadequate, both in capacity and design, and expansion is impossible from the present locations.

These yards must be removed to some points outlying, beyond the location of the proposed clearing yard, so as to provide for forward movements from the receiving yards.

Freight trains from the four divisions of the Boston & Maine Railroad terminate in their respective pockets or small yards south of Washington Street, Somerville. These small yards, even now inadequate in capacity, were constructed for the several divisions they are supposed to serve when the divisions were independent corporations. As may be supposed, the result lacks any semblance of symmetry, the operation of the same is not economical and expansion along proper lines is impossible.

An enlargement of freight terminal facilities for receiving and classification purposes will be absolutely essential in the near future, counting on a growth of business comparable to that of the last decade, and new areas, outlying further from the terminal proper, should be developed, making the areas at present occupied for this purpose available for the development of passenger terminal facilities and possible future additions to local freight yards.

It is unfortunate that the four divisions of the Boston &

Maine system cannot be terminated in one receiving yard outlying from the present terminals without resorting to the construction of connecting lines from the several main line systems to a central yard, through lands and property of expensive and well-established character. A careful analysis of the cost of these connections, and the interest on the investment, as against the additional cost of operating and maintaining separate terminal yards over one central yard, would alone determine the proper course.

It is possible that the present McLean Asylum parcel can be developed for a freight terminal receiving yard for the four divisions of the Boston & Maine Railroad, as well as for a clearing yard for joint operation. This area must, however, serve for the development of a clearing yard, as this feature is essential to a realization of the proposed system of local freight distribution. This area should also provide for an extension of the present passenger terminal yards.

A careful study of operating and traffic requirements, together with tentative developments of the area in question, would be necessary before a final decision could be reached. It is thought, however, that this area is too small, and at the same time lacks the proper outline, to be subject to advantageous development for the three purposes mentioned.

The following possibilities are suggested, providing for three freight terminal receiving yards, outlying beyond the present terminals: —

Land now owned by the Boston & Maine Railroad, between West Cambridge and Hill Crossing along the Fitchburg division, and the Central Massachusetts branch of the Southern division, partially developed at present and known as West Cambridge yard, is well situated for a receiving and classification yard for all Fitchburg division traffic.

The Nunnery Hill property of the Boston & Maine, located in Somerville on the Western division, south of the Mystic River, may be developed for a freight terminal for Southern and Western divisions traffic. This parcel is also well located for general terminal engine and car repair shops.

Southern division freight traffic may be diverted to the Nunnery Hill parcel by the construction of a new line, 1¼

miles long, from a point on the main line just south of West Medford station along the north bank of the Mystic River to a point on the Medford branch just east of Medford station, thence over the Medford branch and Western division direct to the proposed freight terminal.

Still another possible diversion point is at Bleachery station, just south of Lowell, via the Lowell branch to a junction with the Western division main line at Lowell Junction.

A freight terminal for Eastern division traffic may be advantageously located on the flats adjacent to the main tracks along the Revere Beach, between Revere and Lynn. From a terminal yard at this point a direct connection would be possible to East Boston, via the old Boston & Maine right of way from Revere, across Chelsea Creek and Breeds Island.

A possible alternative location for the proposed Eastern division receiving yard is on the flats south of the main line, between Broadway overcrossing and Eastern Avenue grade crossing, Chelsea. This area would be susceptible of development for storage purposes for East Boston terminal freight as well, and direct access from the proposed yard to the Grand Junction Railroad would be possible for traffic in either direction. This alternate site has this advantage of location at the junction of the two lines, but lacks in possible length that of the first-mentioned site.

In the event of the development of the McLean Asylum parcel as a freight-receiving terminal for the four divisions of the Boston & Maine, Fitchburg and Western divisions traffic should enter over the Southern division tracks. The former would be diverted at Hill Crossing station in West Cambridge, and via the Massachusetts Central and Lexington branches into the Southern division at Somerville Junction. Western division traffic would be diverted at Wilmington Junction to the Lawrence branch, and into the Southern division at Wilmington. This re-routing would require but short stretches of double tracking.

3. Clearing Yard.

A. Location. — The location proposed is along the northerly side of the McLean Asylum parcel of the Boston & Maine Railroad in Somerville. This location, together with the tentative

layout adopted, is indicated on drawing appended, Plate II. The elevation suggested for the yard is +12, about 5 feet below the present grade of the Eastern and Western divisions tracks near East Somerville station, as indicated on profile, Plate VI., appended. Through the center of the yard would be located running tracks for through movements. These tracks would serve for through runs on the Grand Junction Railroad, and as might be necessary for direct movements from the several receiving yards to the local delivery yards.

B. Capacity. — Four pockets or groups of tracks are indicated, the ladder angles employed being 1 : 3½. The longest tracks in the double end pockets have a capacity of 45 40-foot cars, and the shortest tracks, 25 40-foot cars. The outline indicated provides a width, in addition to that required for through running tracks, sufficient for sixty-four parallel tracks at 12-foot centers, having an aggregate capacity of over 2,200 40-foot cars.

C. Operation. — The storage capacity is not alone representative of the effective capacity of the clearing yard, which is mainly dependent upon the facility, speed and general efficiency with which the yard may be switched or worked in the processes of classifying or sorting the cars.

The switching track or tracks for operating the yard will extend easterly under the passenger tracks of the Western and Eastern divisions, adjacent to the tracks of the Mystic Wharf branch.

The grades suggested for these switching tracks, together with those of the Mystic Wharf branch, are indicated on the profile, Plate VI., appended.

The overcrossing of the Eastern and Western divisions passenger tracks at the neck of the yard is an obvious though in no wise a prohibitive objection to the means proposed for switching the yard. The side clearances of the bridge should be greater than is required strictly for clearance in order to provide a partial view of the ladder tracks.

The clearing yard will serve for the classifying or sorting of all cars entering over the Boston & Maine system for local delivery in Boston.

4. Connections.

On the basis of three separate outlying terminal receiving yards for the Boston & Maine system, provision should be made for movements as follows: —

From the receiving yards —

Boston & Albany Railroad, ...	Beacon Park yard.
Boston & Maine Railroad: —	
Fitchburg division, ...	West Cambridge yard.
Southern division, ...	Nunnery Hill yard.
Western division, ...	Nunnery Hill yard.
Eastern division, ...	Revere Beach yard.

via the proposed clearing yard to the local delivery stations and marginal railroads.

East Cambridge yard (Boston & Albany).
East Cambridge yard (Boston & Maine).
Minot Street yard (Boston & Maine).
Rutherford Avenue yard (Boston & Maine).
Warren Bridge yard (Boston & Maine).
Mystic Wharf yard (Boston & Maine).
Hoosac Wharf yard (Boston & Maine).
East Boston terminal yard (Boston & Albany).
Chelsea freight yard (proposed).
East Boston marginal railroad (proposed).
Union Freight Railroad.

A. Between Receiving Yards and Clearing Yard. — From the Beacon Park yard of the Boston & Albany access to the clearing yard would be direct via the Grand Junction Railroad.

It is proposed to divert all Fitchburg division freight, except that for points on the division between West Cambridge and Boston, at West Cambridge yard, via Central Massachusetts branch to North Cambridge Junction, Lexington branch to Somerville Junction, main line Southern division to the proposed clearing yard. This diversion is advisable on account of the impracticability of connecting the Fitchburg division with the proposed clearing yard, except by a new line about half a mile long, through improved and expensive property in Somerville.

The connecting route from West Cambridge yard to the proposed clearing yard should ultimately develop into an independent double-track line where it is adjacent to the Southern Division passenger tracks. As an initial step, however, and until Southern division passenger traffic becomes more intense, following electrification and consequent increase in suburban traffic, the present Southern division main tracks, from Somerville Junction to Cross Street, where the descent to the proposed clearing yard begins, are believed to be ample for these additional freight movements.

From West Cambridge yard one additional track adjacent to the Central Massachusetts branch would give a double-track line to North Cambridge Junction, where the line would connect at grade with the double track Lexington branch.

Operating over the Lexington branch to a point westerly of Somerville Junction, the two freight tracks would leave the Lexington branch on the right and descend to a point of crossing under the main track of the Southern division, just westerly of their present junction with the Lexington branch. To effect and simplify this grade separation, the present Southern division and Lexington branch tracks should be elevated at the proposed point of crossing, the elevation beginning at Somerville Junction station and running out some half a mile west thereof. It is desirable to effect this crossing under the Southern division main line with the proposed freight connection, and carry the line on the northerly side of the main tracks, as the three station buildings within this territory, Prospect Hill, Winter Hill and Somerville Junction, are on the southerly side of the main line tracks.

From the point of crossing under the Southern division main tracks the proposed two freight tracks would ascend to a point near Central Street overcrossing, east of Somerville Junction station, where they meet the existing grade of the Southern division tracks. From this point the freight tracks continue adjacent to the present tracks, on the northeasterly side thereof, to a point near Cross Street overcrossing, where they begin to descend on a 1 per cent. grade to reach grade approximately +12, at the neck of the proposed clearing yard just south of

Washington Street. It is apparent that to effect this depression the existing Washington Street undercrossing must be changed to an overcrossing, which feature will be taken up below under the general subject of "Grade Crossing Eliminations."

From the proposed Nunnery Hill freight terminal of the Western and Southern divisions, access would be direct to the proposed clearing yard, via independent tracks, adjacent to the Western division.

From the proposed new Eastern division freight terminal near Revere, a short double-track connection (on the southeasterly side of and adjacent to the Eastern division main tracks) to a junction with the tracks of the Grand Junction Railroad just west of Broadway overcrossing, Chelsea, would give direct access to the proposed clearing yard, via the Grand Junction Railroad.

B. Between Clearing Yard and Local Delivery Yards. — From a point on the proposed new line and grade of the Grand Junction road, about half-way between the Somerville Avenue and the Southern division overcrossings, a connection to the Minot Street and East Cambridge yards would lead southerly, parallel to the Southern division main line, to a point of crossing under the Fitchburg division tracks at about elevation 0. From this point the present Southern division tracks would be depressed and become a part of the proposed connection, intersecting the present grade just north of Water Street.

A change in alignment of the Southern division main tracks is proposed from a point just north of the crossing over the Fitchburg division tracks. This relocation will release the present Southern division alignment, between the Fitchburg division crossing and the Charles River, exclusively for freight movements from the proposed clearing yard.

By reason of the change in alignment of the Southern division, maintenance of the present crossing over the Fitchburg division would be unnecessary, and it is proposed to raise the Fitchburg tracks from Somerville Avenue over the connection outlined above to the Minot Street yard. This suggested grade change is indicated on profile, Plate VI., appended.

From a point on the proposed new line and grade of the

Grand Junction Railroad, just east of the overcrossing of the Western and Eastern divisions main tracks, a connection would be made with the present Mystic Wharf branch which will pass under Rutherford Avenue and Main Street, a separation of grades being made at the crossings of these thoroughfares. Another connection would swing southerly from approximately the same point, and serve to reach Rutherford Avenue yard, the Warren bridge yards on both sides of the Charles River and the Union Freight Railroad.

The installation of the connections as outlined above will obviate all freight movements over main line passenger tracks between receiving yards, clearing yard and local freight yards. It will of course be necessary to maintain certain grade crossings, for freight movements only, at both necks of the proposed clearing yard.

C. Direct Movements. — In addition to the two classes of movements mentioned, viz., from receiving yard via the clearing yard, for the purpose of classification, prior to delivery at the local yard, and from receiving yard direct through the clearing yard to the local yard, when no sorting is necessary there is a third class of movements provided for in some instances, namely, from the receiving yard direct to the local delivery yard, without passing through the clearing yard. These through movements, however, in some instances entail crossings of passenger traffic.

The connections suggested, and indicated on drawing, Plate II., appended, permit of the making up of solid trains at the Mystic Wharf, Rutherford Avenue or Warren bridge local delivery yards, for routing over any division.

The grades suggested are indicated on profile, Plate VI., appended.

5. Elimination of Crossings at Grade with Public Thoroughfares.

A. Grand Junction Railroad. — The following grade crossings of public thoroughfares are maintained at present: —

1. Massachusetts Avenue (street railway tracks), . . Cambridge.
2. Main Street (street railway tracks), . . . Cambridge.
3. Harvard Street, ... Cambridge.
4. Broadway (street railway tracks), ... Cambridge.

5.	Binney Street,	Cambridge.
6.	Cambridge Street (street railway tracks),	Cambridge.
7.	Medford Street,	Somerville.
8.	Somerville Avenue (street railway tracks),	Somerville.
9.	Second Street,	Everett.
10.	West Third Street,	Chelsea.
11.	Everett Avenue (street railway tracks),	Chelsea.
12.	Spruce Street,	Chelsea.
13.	Sixth Street,	Chelsea.
14.	Arlington Street,	Chelsea.
15.	Cottage Street,	Chelsea.
16.	Eastern Avenue,	Chelsea.
17.	Clyde Street,	East Boston.

The various manufacturing interests and the local freight yards may best be served by tracks at established grades, viz., in general conformity with the ground surface. These grades may be maintained by carrying the thoroughfares over the tracks.

The importance of the thoroughfares crossed in Cambridge between Charles River and Somerville Avenue, chiefly Massachusetts Avenue, Broadway, Main Street and Cambridge Street, — all of which are main arteries for team traffic to and from Boston, and which incorporate in their sections electric street railway tracks as well, — renders it most desirable to maintain these thoroughfares at present grade. Such a course is, however, believed to be inexpedient in view of the number of local industries now served within this location at existing track grades, and elimination should be effected by carrying the thoroughfares over the tracks.

The balance of the grade crossings on the Grand Junction Railroad through Everett and Chelsea, namely, Second Street, West Third Street, Everett Avenue, Spruce Street, Sixth Street and Arlington Street, between East Everett and Chelsea stations, are applicable as well to the main line tracks of the Boston & Maine, Eastern division. Cottage Street and Eastern Avenue crossings, between Broadway and Chelsea Creek bridge, will be eliminated for through movements by the proposed connecting railroad from the Grand Junction Railroad to the suggested marginal railroad in East Boston, to be discussed below.

It should be borne in mind that with any elimination of the

grade crossings along the Eastern division within the territory in question provision should be made for four tracks, to provide for double tracking the Grand Junction Railroad.

B. Fitchburg Division, Boston & Maine Railroad. — Between Boston and the elimination recently completed at Belmont station there are eight grade crossings, as follows: —

Somerville Avenue (street railway tracks),	Somerville.
Medford Street (street railway tracks),	Somerville.
Webster Avenue (street railway tracks),	Somerville.
Newton Street (street railway tracks),	Somerville.
Dane Street,	Somerville.
Park Street,	Somerville.
Sherman Street,	Cambridge.
Hill Crossing,	Cambridge.

At present the two latter crossings, in Cambridge, are not important, as street traffic is comparatively infrequent. In both cases the elimination will be comparatively simple when the same becomes urgent by elevating the streets and carrying them over the tracks.

The crossings through Somerville, from Somerville Avenue to Park Street, inclusive, five in number, Webster Avenue and Newton Street being essentially one crossing, are all important thoroughfares, and plans for their elimination have been prepared by the railroad company and approved by the Railroad Commission. These plans provide for carrying all streets over the tracks which are maintained at existing grades, with the exception of Medford Street, which, in order to reduce consequential damages, is depressed about 8 feet and carried under the tracks, which are raised some 10 feet at this point.

C. Southern Division, Boston & Maine Railroad. — The only grade crossings on the Southern division main line between Boston and North Somerville station are East, Short and Water streets, in East Cambridge. Just north of the bridge over the Fitchburg tracks it is proposed to swing the Southern division tracks to the east and carry them adjacent to and parallel with the Fitchburg alignment, on a descending grade, bringing the four divisions together about 500 feet northerly of the Prison Point bridge.

This revision will obviate grade crossings by passenger traffic of the three streets in question, and as they are unimportant streets, serving only a small area between Miller's River and the present Southern division, grade separation is unnecessary. The East Cambridge station should be relocated some 1,500 feet northerly from its present location, where it will serve both Southern and Fitchburg divisions traffic.

The necessity of carrying Washington Street above the Southern division tracks, instead of below, as at present, was mentioned above in connection with the proposed diversion of Fitchburg division freight traffic at West Cambridge yard to the clearing yard via the Southern division. From a point near Prospect Hill station the Southern division main tracks would begin to descend southerly, on a 1 per cent. grade, reaching an elevation about 7 feet below their present grade at Washington Street, whence they would ascend to an intersection with the existing grade, as indicated on profile, Plate VI., appended. The general grade of Washington Street is only slightly below the present track grade at the bridge, and with the railroad lowered 7 feet the approach grades will be quite as short for an overcrossing as for an undercrossing.

D. Lexington Branch, Boston & Maine Railroad. — Between Somerville Junction station and North Cambridge Junction station there are at present eight grade crossings, as follows: —

Cedar Street,	Somerville.
Willow Street,	Somerville.
Grove Street,	Somerville.
College Avenue,	Somerville.
Holland Street (street railway tracks),	Somerville.
Cameron Street,	Cambridge.
Massachusetts Avenue (street railway tracks),	Cambridge.
Cedar Street,	Cambridge.

These crossings can all best be eliminated by carrying the thoroughfares over the tracks. Throughout this section, however, the railroad may easily be depressed from 5 to 8 feet, thus simplifying the approach grades to the overcrossings.

E. Western and Eastern Divisions, Boston & Maine Railroad. — There are no grade crossings of public thoroughfares on the Western division in the immediate vicinity of the terminal. On the Eastern division, in addition to the six crossings through Everett and Chelsea, mentioned under the Grand Junction Railroad, there is one other crossing, Eastern Avenue, about half a mile east of Chelsea station. Grade separation may best be effected at these points by carrying the thoroughfares over the tracks.

F. Mystic Wharf Branch, Boston & Maine Railroad. — There are two important grade crossings on this line, Rutherford Avenue and Main Street, both in Charlestown, the latter thoroughfare having within its section electric street railway tracks and the double track elevated structure of the Boston Elevated Railway. In addition to the regular train movements over the branch, the switching movements incident to working the proposed clearing yard will cross both of these thoroughfares, making a separation of grades absolutely essential. Elimination of these two grade crossings may best be effected by compromise grades, carrying the streets over the tracks. The grades suggested are indicated on profile, Plate VI., appended, whereon the approach grades of the streets are also indicated.

G. Hoosac Wharf Branch, Boston & Maine Railroad. — There are two grade crossings on this line near City Square, Charlestown, the only important one being Warren Avenue, which embodies an electric street railway line. Although the street traffic on Warren Avenue is heavy, the number of train movements will diminish, as the wharves are abandoned, for any considerable volume of export traffic, in favor of modern terminals at South Boston and East Boston. In view of the above no expenditure is warranted in eliminating the grade crossings on this branch.

H. Boston & Albany Railroad. — Aside from those mentioned under the Grand Junction Railroad, the Boston & Albany Railroad maintains no grade crossings with public thoroughfares in the immediate vicinity of Boston.

I. New York, New Haven & Hartford Railroad. — There are no grade crossing eliminations remaining for accomplish-

ment on the Providence division or branches within the city proper.

On the Midland and Plymouth divisions and on the Mattapan branch there are several important grade crossings. No particular study has been made at these points, however, as the disposition of the several problems is in no way dependent on the general development proposed.

6. Improvement of Union Freight Railroad.

To meet the demands of future traffic, the effective capacity of the Union Freight Railroad should be increased. It is believed that with certain physical changes suggested below, and a general readjustment of traffic conditions in Atlantic Avenue, Commercial and Causeway streets, the effective capacity of the freight line will be largely increased, not altogether at the expense of other street traffic, but by eliminating the possibilities of congestion, and by strict regulations for all classes of traffic.

A. Points where Congestion is probable. — In addition to the traffic across the water-front thoroughfares to the various wharves and piers, there are several points where the stream of traffic across the tracks of the Union Freight Railroad is more or less continuous during the daytime, viz.: —

1. Causeway Street at the North station.
2. Warren bridge.
3. Charlestown bridge.
4. Hanover Street to Chelsea Ferry.
5. Battery Street to North Ferry.
6. At Eastern Avenue to South Ferry.
7. At Rowes Wharf to Revere Beach Ferry, and in summer to the Nantasket Beach Steamboat service.
8. Northern Avenue bridge.
9. Congress Street.
10. Summer Street.
11. Atlantic Avenue at the South station.

Suggestions follow for eliminating nine of the above eleven points of possible congestion, no treatment being available within practical limits either at Rowes Wharf or at Northern Avenue bridge.

B. Impracticability of removing Tracks from Streets. — On account of the expensive character of the land and buildings adjoining, it is manifestly impossible to relocate the Union Freight Railroad on private property adjoining the public thoroughfares, even were such a course desirable from other standpoints. A depression of the road throughout its entire length into a subway below the street surface, aside from the expense involved, would preclude the possibility of satisfactory rail service to the piers. An elevation of the road to a structure above the street would require the rebuilding of the present elevated structure, would not serve the piers and other local points as well as a surface line, nor would this arrangement harmonize with the general treatment suggested at the North station. Several grade separations at points of cross traffic are, however, suggested.

C. In the Vicinity of the North Station. — From the proposed clearing yard a connection with the Union Freight Railroad would cross the Charles River on the easterly side of the new railroad bridge (to be discussed at length below), descend on a 2 per cent. approach grade and then continue parallel to the northerly ladder track of the proposed station layout, under ground and in a straight line, to a point under the approach to Warren bridge, at elevation approximately —5. From this point the line and subsurface structure would curve into Causeway Street and continue below the street surface to a portal just east of Charlestown bridge, where a 2 per cent. approach grade would begin to ascend, intersecting the present street grade of Commercial Street near the westerly limits of North End Park.

The route described is indicated on the drawing, Plate II., appended, where the subway and approach are noted. On the profile, Plate VII., appended, the suggested grades are indicated east of Warren bridge, from the point where the line enters Causeway Street. Between this point and the point where the proposed subsurface structure leaves the station layout, the grade is level at elevation approximately —5.

This procedure obviously entails the appropriation of a certain portion of the street width for the approach, between

Charlestown bridge and North End Park. Commercial and Causeway streets are in the main 80 feet or more in width. Opposite the property formerly of the Boston Gas Light Company, now of the Union Freight Railroad, however, throughout practically the entire length of the approach, the street is but about 60 feet wide, — a width insufficient to provide for the approach and other street traffic.

It is proposed to widen the street throughout this stretch by adding to its northerly side a strip from railroad property. A street width of 80 feet will provide an ample width for the double track approach in the center of the street, and roadways on either side of 19 feet clear width, as well as two 7-foot sidewalks, the same as at present.

The 19-foot roadways, entirely too narrow for unrestricted traffic, would, under proper regulation, serve for traffic in one direction only. The location of columns supporting the elevated structure are at present along the curb lines. Under the proposed arrangement, the columns along the present northerly curb would rest on the northerly retaining wall of the approach. Without shifting the location of the elevated structure, a 19-foot roadway and a 7-foot sidewalk represents the maximum development possible along the southerly side of the street, maintaining the present southerly street line. Along the northerly side of the street the width of roadway and sidewalk is dependent on the additional street width annexed.

The above treatment would remove the freight road from paths of cross traffic of great intensity at three points, viz., across Causeway Street at the North station, at Warren bridge and at Charlestown bridge. The 2 per cent. grades adopted, although much in excess of desirable limiting grades for ordinary freight traffic, are entirely consistent with the hauling capacity of the modern electric locomotive (as all suggestions are based on the ultimate electrification of the road, together with the other steam lines within the city) and the length of train which can safely and expeditiously be hauled through the street, allowing for the large amount of vehicular traffic which must cross the thoroughfare to reach the various piers and wharves.

Based on present practice, a 100-ton electric locomotive

should develop a maximum tractive effort of about 50,000 pounds. Under ordinary conditions of the rail, a pull of 50 pounds is necessary to move one ton against a 2 per cent. grade. Based on average loading, a train of 1,000 tons gross represents 25 cars, or a length of 1,000 feet. At a rate of 6 miles per hour a 25-car train, 1,000 feet long, would travel its length in about two minutes.

D. At Hanover and Battery Streets. — At Hanover Street, Battery Street and Eastern Avenue there are well-defined lines of cross traffic leading to the ferries. It is impracticable to extend the subway for the freight tracks above suggested under the paths of cross traffic at these three thoroughfares, on account of the necessity of maintaining service at the street grades on the contiguous piers and wharves.

It is suggested to eliminate these points of possible congestion by removing the South Ferry, now served at Eastern Avenue, grouping all the ferries at the foot of Hanover and Battery streets, and carrying these two thoroughfares over Commercial Street. The disposition of traffic to and from the ferries, as above, would eliminate three points of possible congestion, in addition to the three in the vicinity of the North station, above outlined.

This possible treatment at Hanover and Battery streets is offered as a suggestion for further study. The present traffic to and from the ferries, except at the rush hours of morning and evening, would not warrant even a small part of the expenditure necessary to carry out the grade separations. It is the future ferry traffic, as well as the freight traffic, which must determine the questions.

E. At Rowes Wharf and Northern Avenue Bridge. — No practicable treatment is readily discernible either at Rowes Wharf or at Northern Avenue bridge for separating the cross traffic from that in Atlantic Avenue. Present traffic to and from the Revere Beach ferry would, of course, be eliminated should the Revere Beach road be brought into the city proper, as discussed below.

F. In the Vicinity of the South Station. — A connection across Northern Avenue bridge from the Union Freight Railroad tracks in Atlantic Avenue to the Congress Street local

delivery yard of the New Haven at South Boston should be permitted. After this connection is installed and in operation, all freight movements between the New Haven system and the Union Freight Railroad will be via this new connection, and that portion of the road in Atlantic Avenue between the Northern Avenue bridge and the present terminals at the South station would avail for Boston & Albany interchange only.

Under the system of local freight distribution proposed, Boston & Albany traffic destined to points on the Atlantic Avenue water front will be handled via the Grand Junction Railroad and the proposed clearing yard to a connection with the Union Freight Railroad at the North station. Such an arrangement would make possible the removal of the present freight tracks in Atlantic Avenue, south of the Northern Avenue bridge, and so eliminate the three remaining points of possible congestion, at Congress and Summer streets and across Atlantic Avenue adjacent to the South station.

The realization of the improvements suggested in the vicinity of the North and South stations would result in a double track road throughout, and would remove from city streets about 1 mile of the approaches to the effective portion of the road, reducing the length from 2¼ to 1¼ miles.

G. Street Car Traffic. — The tracks of the Union Freight Railroad lie between the lines of columns supporting the elevated structure. The surface car tracks as a rule occupy that portion of the street between the curb line and the line of columns. If such a course were possible, consistent with the best interests of public service, it would be eminently desirable to remove the street car tracks from Commercial Street and Atlantic Avenue, between Charlestown bridge and Northern Avenue bridge, and thus, assuming that the streets were properly paved, increase the capacity of the thoroughfares for vehicular traffic. This course might be possible by increasing the facilities for elevated traffic between points along the water front by the installation of three additional stations, at Pearl Street, Commercial Street and North End Park.

H. Possible Development of Gas House Property. — The future use of the old gas house property on Commercial Street, now belonging to the Union Freight Railroad, is open to specu-

lation. This parcel, about 700 feet long and less than 300 feet wide, from Commercial Street to the harbor line, is not of sufficient size to permit of any comprehensive development into docks and wharves. Even were additional areas appropriated to render possible the development of all the property between Charlestown bridge and North End Park, thus rendering available about 1,000 feet of water front, the depth of the parcel is so limited as to preclude the possibility of any extensive development for vessels of any size.

The parcel is directly opposite the Hoosac Docks of the Boston & Maine Railroad, where the width between established harbor lines is only about 650 feet. The site is, however, susceptible of development as a local delivery yard. Under the proposed system of distribution, a yard in this locality is neither necessary nor desirable. The parcel is but one-quarter of a mile from the Warren bridge yard of the Boston & Maine Railroad, and by the suggested straightening of the Charles River bulkhead lines in the vicinity of the North station, to be described below, additional areas are annexed to this yard. It is indeed desirable to have an additional yard for local delivery in Boston proper, but this yard should be located more nearly midway between the Warren bridge yard of the Boston & Maine Railroad and the Congress Street yard of the New Haven road at South Boston. The proposed Atlantic Avenue local delivery station will be discussed below.

I. Summary. — The present haphazard condition of traffic in Atlantic Avenue and Commercial Street cannot continue indefinitely, nor can adequate provision be made for the effective handling of any great increase in all classes of traffic. The demands of certain classes must be retired in favor of others which are believed to be more important to the general development of the community.

The suggestions embodied herein aim to increase the effective capacity of the Union Freight Railroad and also the capacity of the water-front thoroughfares between the North and South stations for vehicular traffic. The surface car traffic alone is retired in favor of the demands for the satisfactory and expeditious movement of freight.

7. *Proposed System of Car Floats.*

In connection with the general development suggested for a system of local freight distribution, car-float service is proposed for the transfer of through freight from the north to the south side systems. This service would ply between Mystic Wharf and South Boston, and touch at the proposed Atlantic Avenue local delivery yard described below. An effective car-float service operating within those limits would relieve the Union Freight Railroad of through movements if required, and would provide an additional means of delivery to points on the Atlantic Avenue water front.

8. *Additional Local Delivery Stations.*

In order to provide a thoroughly effective system of local freight distribution for certain districts, facilities for local delivery should be increased.

A. Chelsea. — There is at present, in the vicinity of Chelsea station, a local delivery yard served direct by the Eastern division of the Boston & Maine Railroad. Another independent yard is about to be installed in connection with the Grand Junction branch of the Boston & Albany Railroad.

In line with the ultimate development suggested, a joint yard of adequate capacity should be installed, with service direct from the proposed clearing yard via the Grand Junction Railroad.

B. Atlantic Avenue. — In connection with the proposed district system of local freight distribution, an additional local delivery yard is suggested on the harbor side of Atlantic Avenue, together with new piers having an effective length of 700 feet. These facilities entail the reconstruction of the water front between Long Wharf and Union Wharf, as indicated on the drawing, Plate II., appended.

The arrangement of the present slips and piers for the entire water front north of Long Wharf is most ineffective. The stable character of the buildings on wharf property between Union Wharf and Fiske Wharf, inclusive, comprising several modern storage warehouses, important factories and the power

house of the Boston Elevated Railway Company, precludes the possibility of any immediate reconstructions within these limits.

Between Long Wharf and Union Wharf, however, there are no modern structures, except that of the Quincy Market Cold Storage and Warehouse Company, adjacent to Eastern Avenue on the north, the permanent character of which is recognized, and it is believed that throughout this stretch a reconstruction of the water front would prove of immediate advantage to the shipping interests which should have wharfage on the water front of Boston proper. This measure appropriates T Wharf and the slips at present utilized by the fishing interests, which would be forced to some new locations, possibly in South Boston, as has been suggested.

The area now occupied by the ferry house and slips of the South Ferry is also utilized in the suggested development. This course forces the removal of the ferry terminal, and provision is suggested for this service at the present terminal of the North Ferry at the foot of Battery Street, the North Ferry in turn being relocated with the Chelsea Ferry at the foot of Hanover Street, as outlined above.

A tentative layout of the area it is proposed to develop for an additional local delivery yard indicated provides the following: —

Freight house, 50 feet by 600 feet.
House tracks, capacity, 52 40-foot cars.
Team tracks, capacity, 82 40-foot cars.
Transfer tracks, leading to the transfer bridge, for the storage of cars in connection with the proposed car-float service, capacity 32 40-foot cars.
Total capacity, 186 40-foot cars.

In addition to the above, the tracks on the proposed piers, and for general storage and switching purposes, have a capacity of about 160 cars.

It is proposed to establish the bulkhead line along the inner end of the slips sufficiently far from the easterly line of Atlantic Avenue to provide for three tracks entirely outside of the street

section, each about 1,500 feet long, extending between connections with the main tracks of the Union Freight Railroad at State Street and at Eastern Avenue. These tracks would serve as switching and storage tracks, so that no standing or switching of cars would be necessary on the main tracks in Atlantic Avenue in working the proposed new yard and pier tracks.

The new Atlantic Avenue local delivery yard would serve the market district only, which under the district system would comprise an area or business section entirely consistent with the capacity of the proposed yard. Business houses within this prescribed area would as a rule be served at this yard. This would result in a still further reduction in the ton mileage teamed through the business thoroughfares of the city over that which it has been shown would follow the application of the district system of delivery to the present local delivery yards only.

C. Points on Revere Beach Road. — After the installation near the northerly limits of East Boston of certain connections which are suggested pursuant to the proposed development of the easterly water front of East Boston, and subsequent to the suggested reconstruction of the Boston, Revere Beach & Lynn Railroad on a standard-gauge basis, all of which will be discussed at length below, the local delivery of freight to points on the Revere Beach road in Winthrop and Revere will be possible direct from the proposed clearing yard.

9. Transfer Facilities.

Through the operation of the proposed clearing yard and the connections suggested, the interchange of tonnage in car-load lots between the several entering trunk lines and the various local delivery stations and docks will be possible with few limitations.

We still have to provide for the distribution of goods arriving in less than car-load lots. Tonnage of this sort, for purpose of discussion, is subject to a strict division into four classes, as follows: —

First. — Goods for distribution among two or more district

delivery stations, near the terminus of the trunk line entering the tonnage.

Second. — Goods for distribution among any two or more district delivery stations within the terminal.

Third. — Goods for distribution to various points on the several lines or branches of the system entering the tonnage.

Fourth. — Goods for distribution to various points on any of the several lines or branches.

Specific recommendations in the premises would be unwarranted without an intimate knowledge of the relative amounts of tonnage requiring transfer under the above classification. As data of this nature are not at hand, only general suggestions can be offered.

As was brought out above, under the present system of operation practically all transfers required on goods entering Boston, except those coming within the third class, are performed by means of teams. In accordance with best practice these transfers are usually effected by means of a series of transfer platforms, against which the through car and the local cars are placed, the goods being trucked direct from one car to the other.

Under the proposed system it is probable that those transfers coming within the first and second classes would still be effected by means of teams. That is, all goods for local delivery entering the district in less than car-load lots would be delivered at the local yard of the line entering the tonnage, and from there distributed by teams.

In the transfer of goods coming within the third and fourth classes, transfer houses or platforms should be provided. Facilities for this purpose, adequate in size and design, installed in connection with the proposed clearing yard, will serve for all transfers coming within the fourth class, that is, for all goods in less than car-load lots entering over any trunk line, and destined for points on other lines.

Transfers coming strictly within the third class would be effected at the existing terminal yards as at present for the New Haven and the Boston & Albany systems, and for the Boston & Maine system the transfer facilities at the clearing yard would avail.

10. Limitations in Proposed System.

There are obviously certain practical questions of operation which limit the flexibility of the system, even though physically the movements are possible. For instance, tonnage entering over the New Haven system, to reach Kneeland Street and Huntington Avenue yards in order to obviate a grade crossing with the passenger tracks at the neck of the South Station yard would be subjected to an impracticable detour around the city via the Union Freight Railroad, the proposed clearing yard, the Grand Junction Railroad to Beacon Park yard and the Boston & Albany main line. In this particular case cited the limitation is not serious, as the Congress Street and Kneeland Street yards are comparatively near together.

The deliveries indicated in the following table are considered entirely practicable.

Delivery at—	From Boston & Maine via—	From Boston & Albany via—	From New Haven via—
East Boston,	Clearing yard. (Direct for Eastern division.)	Direct,	Car floats.
Chelsea,	Clearing yard. (Direct for Eastern division.)	Direct,	Union Freight Railroad and Grand Junction Railroad.
Mystic Wharf,	Clearing yard and direct.	Clearing yard and Mystic Wharf bridge.	Car floats.
Rutherford Avenue,	Clearing yard and direct.	Clearing yard,	Union Freight Railroad.
Warren bridge,	Clearing yard and direct.	Clearing yard,	Union Freight Railroad.
Minot Street,	Clearing yard,	Clearing yard,	-
East Cambridge (Boston & Maine),	Clearing yard,	Clearing yard,	-
East Cambridge (Boston & Albany),	Clearing yard,	Direct,	-
Atlantic Avenue,	Clearing yard and Union Freight Railroad.	Clearing yard and Union Freight Railroad.	Union Freight Railroad.
Congress Street,	Clearing yard and Union Freight Railroad.	-	Direct.
Massachusetts Avenue,	Clearing yard and Union Freight Railroad.	-	Direct.
Kneeland Street,	-	Direct,	-
Huntington Avenue,	-	Direct,	-

Free Storage.

In accordance with existing statute requirements the railroad companies in Massachusetts are compelled to allow four days, or ninety-six hours, in which the consignee may unload his freight, and a like period for loading. This allowance was formerly even greater, the fixing of the present free-storage limit being of comparatively recent date. The limit existing in most other eastern States is forty-eight hours for unloading and a corresponding period for loading, just one-half of the allowance prevailing throughout the Commonwealth.

With freight cars moving on an average of but 25 miles per day throughout the entire year, it is manifestly unjust to burden a carrier company, whose freight revenue is dependent solely on ton mileage accomplished, with requirements for free storage beyond that period which is absolutely necessary to unload the car. Forty-eight hours is considered, and generally acknowledged, ample for this purpose. The effective capacity of all the local delivery yards in Boston, especially of those whose car-storage capacity is limited in comparison with the business handled, would be very greatly increased were the free storage limit reduced to forty-eight hours.

III. PASSENGER TRAFFIC, PRESENT STEAM LINES.

Statistics, 1908.

1. Train Movements.

During the summer season of 1908 the following metropolitan trains, in addition to the through express trains, entered and left Boston: —

Schedule of Train Movements for Twenty-four Hours.

RAILROADS.	Inbound.			Out-bound.	Grand Totals.
	6.30 to 9.30 A.M.	8 to 9 A.M.	Totals.		
Boston & Maine Railroad:—					
Eastern division,	21	10	76	71	147
Western division,	21	8	76	73	149
Southern division,	15	6	42	38	80
Lexington branch,	9	4	28	28	56
Massachusetts Central branch,	5	2	12	11	23
Fitchburg division,	16	8	52	48	100
Total at North station,	87	39	286	269	555
New York, New Haven & Hartford Railroad:—					
Providence division,	33	14	113	113	226
Midland division,	20	10	51	51	102
Plymouth division,	40	17	120	114	234
Totals,	93	41	284	278	562
Boston & Albany Railroad:—					
Main line,	20	10	65	63	128
Newton circuit,	10	4	32	32	64
Totals,	30	14	97	95	192
Total at South station,	123	55	381	373	754
Boston, Revere Beach & Lynn Railroad,	18	6	94	94	186
Grand totals,	228	99	761	736	1,497

2. Passengers handled.

Under the above schedule of train movements it will be noted that in the busiest hour, from 8 to 9 o'clock A.M., 99 trains enter the city. From actual passenger returns, in round numbers 51,000 suburban passengers on 228 trains enter the city over the several lines and branches of the four railroad systems between the hours of 6.30 and 9.30 A.M. Pro rata, 22,200 passengers enter the city from 8 to 9 o'clock.

Bulletin No. 14, Decennial Census of 1905, issued by the Commonwealth's Bureau of Statistics of Labor, gives the working population entering the city daily from suburban territory within 15 miles of Boston in round numbers as 77,500. It is apparent that about three-fifths of this number enter the city via the present steam lines.

Following electrification and the consequent improvement in suburban traffic facilities the effective commutation radius will be increased to 25 or 30 miles. This will increase the rate of growth of suburban traffic beyond that which may be looked for strictly from the normal increase in the population. On the other hand, as the rapid-transit system is extended, it is fair to assume that many of the working class in the immediate suburbs who now enter the city via the steam lines will use the projected subway or elevated lines.

In order to forecast a reasonable maximum hourly traffic burden, in figuring against the ultimate capacity of the limiting features outlined below, 23,000 passengers per hour in 1908 is a fair basis for prognostication.

Main Features of Present System.

1. Difficulty in providing for Increased Traffic.

There are no special features in the properties, traffic or operation which particularly characterize the passenger service of the existing steam roads in Boston at the present time.

The operation is strictly terminal, there being no through or loop movements at the terminal stations. Operation on this terminal basis obviously entails reverse movements, for all except spot trains, from the train shed to the terminal storage yard for passenger equipment. The so-called spot trains, always for local or suburban service, are not turned, nor do they leave the train shed, except on outbound schedule. The locomotive inbound cuts off in the train shed, and a second locomotive is put into service for the next outbound run of the train.

The great majority of these reverse movements of inbound trains, after discharging passengers, from the train shed to the terminal yard, where locomotives and cars are turned, cleaned, restocked and again made up in the proper order for outbound service, must cross inbound traffic at the entrance to train-shed yard. This is also true in movements of trains for outbound service, made up in the terminal yard and backed into the train shed for the loading of passengers and baggage prior to regular schedule movement outbound.

Provision must always be made at the entrance to any yard

serving two or more divisions or systems, by an adequate system of signals and interlocking, for the crossing of numerous movements of regular traffic. This class of cross-traffic movement can only be avoided by the installation of a more or less complex system of track-grade separations at the entrance to the yard.

The observance of a proper system of signals renders this operation for regular traffic reasonably safe and expeditious, but as the traffic requirements increase, the idle movements and crossings incident to terminal operation multiply rapidly, thus increasing the possibilities of accident or congestion and consequent delay.

These reverse movements of trains that have completed their run, as well as movements into the train shed of empty trains prior to loading, in fact, all movements incident to a regular day's business, are to the despatcher as much a part of the regular operating schedule as the movement of trains listed for public service in the time-table. Up to a certain limit, so long as this schedule is strictly maintained there is no congestion, no matter how intense the traffic may be.

As traffic requirements increase, additional trains become necessary, and during rush hours platform service tracks must be cleared more quickly. Ordinarily every additional train entails three crossings of traffic at the neck of the train-shed yard. The intensity of traffic at this point increases, and with it the possibility of congestion. Upon the slightest upset to the schedule, the stability of the system is shaken, and results detrimental to regular and dependable public service become very far-reaching.

Based on the present rate of increase of passenger traffic the railroad managements will soon be confronted with the economic necessity of providing, both at the North and South stations, increased facilities, not merely to accommodate with safety and regularity traffic immediately in hand, but in anticipation of the requirements of service for many years' growth at a like or greater rate. The system devised should provide for the greatest flexibility in operation, a characteristic which is virtually insurance against indeterminate operating, or traffic requirements which may arise in the future.

2. Terminal Yards for Passenger Equipment.

The present terminal yards for the storage, cleaning, restocking and turning of passenger equipment, of the three railroad systems entering Boston, are variously located as follows: —

The Boston & Maine Railroad maintains and operates three separate and distinct yards, located north of the Charles River. These yards serve the several divisions in much the same manner as before the consolidation of the properties.

The Boston & Albany Railroad maintains and operates two yards, one at Huntington Avenue, about 1½ miles from the South station, for cars only, and a second in connection with the Beacon Park freight terminal yard, west of Cottage Farm, about 4 miles from the South station, for locomotives only. The terminal facilities for passenger locomotives, until recently maintained at Albany Street, at the entrance to the Kneeland Street yard, have been demolished in order to provide additional room for local delivery tracks, and locomotives formerly accommodated at this point now run to Beacon Park yard.

The New Haven road maintains and operates two yards, one, east of Fort Point Channel, between the main tracks of the Midland and Plymouth divisions and Dorchester Avenue, and a second, about 2¼ miles from the South station, on the Providence division, south of Massachusetts Avenue, adjacent to the Huntington Avenue baseball grounds.

Thus under the present system there are maintained and operated seven separate yards for passenger equipment.

Alternate Lines of Development to be considered.

1. Development of Additional Areas.

Along lines of general analysis, several methods for the development of properties to meet future traffic requirements should be mentioned, although the first and second are believed to be inadequate for the best development on broad lines.

First. — The development of new areas, separated from the present terminals, for new terminals to supplant the present North and South stations, or for additional terminals to serve

certain trains or classes of trains, in order to relieve the present stations.

Second. — The construction of a loop, with a second tier of platform tracks, both at the North and South stations, for the turning of all suburban or local trains without cross-traffic movements.

Third. — The construction of a sub-surface connection between the two present terminal stations, in order to provide for through movements for all trains.

The actual possibilities that may be mentioned under the first two classifications, with the apparent limitations and objections, are as follows: —

A. Southern Terminal. — (*a*) Huntington Avenue Yard of the Boston & Albany Railroad. — This parcel, lying between Boylston Street, Huntington Avenue and Mechanics Hall and running from Exeter Street to Dalton Street, at present utilized by the railroad company in part as a storage and cleaning yard for passenger equipment and in part as a freight yard for local delivery, in itself is susceptible of satisfactory development into a terminal station and grounds to serve New Haven, Providence division, as well as Boston & Albany traffic.

The following objections to any development at this location are too important to permit of serious consideration of this suggestion: —

First. — The difficulty of entering New Haven traffic to the site, on account of the well-established and expensive class of property intervening.

Second. — The location is not suited to the requirements of the travelling public on account of its distance from the business parts of the city.

Third. — The parcel is not large enough for a storage and cleaning yard for terminal equipment in addition to the space requirements for a terminal station and grounds proper, hence additional areas lying further out would have to be appropriated for this purpose.

Fourth. — The location is in the midst of an almost exclusively residential district, and such an enterprise would tend to depreciate property in the neighborhood.

Fifth. — This development would not provide the desirable flexibility to meet future contingencies of traffic and operation, and would in reality represent a most expensive treatment of but one isolated point of the transportation problem taken as a whole.

(*b*) Park Square Property of the New Haven Road. — This parcel, which, prior to the completion of the South station, was occupied as terminal grounds for New Haven, Providence division, traffic, has some advantages over the Huntington Avenue yard of the Boston & Albany Railroad as it is nearer to the business center of the city, and is easily accessible for New Haven and Boston & Albany traffic.

The following objections to any general development of this site for permanent terminal may be noted: —

First. — The area, as owned by the railroad company, is not sufficiently large to develop facilities for any complete class of through express service, nor for storage yards for equipment. With a loop, however, thus permitting through operation, a development could be installed sufficient for the handling of all suburban service, as that service might be increased, both from the Boston & Albany main line and Newton circuit as well as from the Providence division of the New Haven road.

The possibility of developing this area as a temporary terminal for suburban service during reconstruction at the South station will be discussed later in the report.

Second. — The same objection as to the lack of flexibility provided by this permanent development applies here as well as to the possible development mentioned above.

(*c*) Kneeland Street Yard of the Boston & Albany Railroad. — This parcel, lying immediately adjacent to the South station property, between Atlantic Avenue and Albany Street, extending from Kneeland Street to the main tracks, is at present utilized for local freight delivery purposes.

This site is the only Boston delivery yard for Boston & Albany traffic, and the maintenance of a local city freight delivery station at this point is believed to be of vast importance to the merchants of Boston.

One can conceive, under a combined management of the New Haven and the Boston & Albany properties, of the diversion

of all freight for city delivery entering over the Boston & Albany Railroad to the New Haven road at South Framingham, and its subsequent local delivery at South Boston. Under a further combination with the Boston & Maine system, delivery of a part or all of the freight to the Boston & Maine Railroad for local delivery on the north side of the city would be physically possible via the Grand Junction Railroad and the proposed clearing yard.

The Kneeland Street local delivery yard is, however, believed to be far too important a feature in the general local freight distribution system proposed for the terminal district to warrant any serious consideration of its abolishment in order to effect an enlargement of the present South station passenger facilities.

Here, again, must be mentioned the lack of flexibility, — a limitation which exists in any strictly terminal plan of development.

B. Northern Terminal. — Removal of North Station to the North Side of Charles River. — There are three extreme cases to be considered in this possible development.

First. — The construction of a new and enlarged north terminal station and grounds for western and northern New England traffic, with no entrance into Boston proper. In this instance the station edifice would be located on or very near the northerly bank of the Charles River, on present Boston & Maine Railroad property, with the terminal grounds extending to the north.

Second. — A similar location of the station edifice and grounds, with entrance into Boston proper via a new railroad bridge across the Charles River, preparatory to continuation into a subsurface connection to the South station. The elevation of the track on this new bridge might be as at present, approximately 17½ feet above mean low water, or raised to elevation 37, to provide a clearance for river traffic of 23 feet above mean high water, as recommended by the War Department. Under this scheme the tracks would descend from the bridge across the Charles River in an open cut across the present North station grounds.

Third. — The location of the new North station edifice and

grounds at a sufficient distance from the north bank of the Charles River to maintain platform tracks in the station at, or slightly below, the present ground surface, and provide for a subaqueous entrance into Boston proper for a connection with the South station, via a tunnel under the river, with permissible approach grades, and provision for 20 feet of water over the tunnel roof, below mean low water. This would bring the elevation of the track in the tunnel under the river at approximately elevation — 44.

The grades and elevations necessary to the adoption of any of the above schemes are indicated on profile, Plate VII., appended, and will be further discussed below.

There are several serious objections which attach to any project contemplating the removal of the North station from Boston proper to the north side of the Charles River. It is believed that adverse sentiment of the traveling public to the removal of the north terminal of the city beyond the limits of the city proper would be practically insurmountable.

The realization of this project would require the complete readjustment of the surface car, subway and elevated distributing system in this locality in order to reach the new terminal station.

Besides appropriating large areas of the present property of the Boston & Maine Railroad in Charlestown for the terminal edifice and grounds themselves, additional areas would have to be appropriated for approaches to the station, so that the present uses of much of the property in the vicinity of the proposed site would be impossible.

The fact that areas much larger than the present terminal grounds would be available for a development to meet future traffic would be a potent argument if strict terminal operation were to be maintained. However, with the terminal features eliminated, the area occupied by the present North station and grounds is ample for future development.

Of the two schemes which leave the present terminal property entirely unencumbered, so far as transportation requirements go, that outlined under " First " above provides for a continuance of terminal operation, and that under " Third " with entrance into

Boston under the Charles River, locates the terminal building about 1 mile from Causeway Street.

In short, any project contemplating the removal of the North station to the north side of the Charles River is considered impracticable.

It is also believed that any development proposed toward increasing present terminal facilities by developing additional areas, maintaining the present system of terminal operation, will prove ineffectual as lacking in flexibility for an enduring system.

C. A Union Station. — The possibility of constructing a union station in connection with a subsurface line connecting the North and South stations has been considered.

Had this project received an exhaustive study prior to the approval of the designs for the new South station, its adoption might have been consistent with ultimate economy in maintenance and operation, and the best possible public service. At present, however, such a measure would render useless the larger part of the present valuable railroad assets at the South station, not to mention those of lesser value at the North station, and would entail the necessity of appropriating over ten acres of land in the heart of the business center of the city. The cost of this real estate, together with the cost of the station facilities and edifice, would be far in excess of the probable cost of development as proposed at the North and South stations.

In addition to the above physical aspects, any proposition to combine at one point the facilities of two important terminals renders street-traffic congestion far more probable, as traffic accommodated under the present arrangement, at opposite ends of the city, would be thrown together into the now crowded thoroughfares near the business center.

It has been suggested, in connection with the through movement of passenger trains between the north and south side systems, that the South station areas might be redeveloped into facilities for a union station, and the North station facilities correspondingly limited, providing at this point a station similar in scope to the Back Bay station.

This measure would involve the handling at the South sta-

tion of practically all of the express, baggage and mail matter now handled at both stations, and the consequent increase in street traffic could not be accommodated in the existing avenues of approach to the South station.

2. A Two-level Station with Loop.

As all studies presented herewith are contingent upon the complete electrification of all passenger lines entering Boston, at least within the terminal district, the maintenance of high vaulted train sheds becomes unnecessary, and a second series of platform tracks might be established from 20 to 25 feet above or below the present level.

The installation of a loop, with an additional system of platform tracks for suburban train service, in a tier above the present surface platform tracks, would provide increased facilities to meet any probable increase in traffic for years to come.

Such an installation, designed to provide for direct movements from any of the new second-tier platform tracks, via the loop, from inbound to outbound running tracks, would obviously eliminate a large percentage of the cross-traffic movements incidental to the present system of operation.

A. North Station. — There is ample space between the present Charles River draw span and Causeway Street, about 1,300 feet, to provide for permissible approach grades (5 per cent., based on the operation of multiple unit electric trains for suburban service), platform tracks for the accommodation of 8 60-foot car trains and a loop of the proper radius to serve all platform tracks at the new or suburban level.

If the grade of the bridge across the Charles River is to be raised about 20 feet, to elevation +37, in order to provide additional clearance for river traffic, the train room and platform tracks for through express traffic would be established at the new or upper level, the development for suburban traffic utilizing the present station level.

If, on the other hand, the entrance grades are to be maintained substantially as at present, the through express tracks

would be at the existing level, and the suburban station would be above.

B. South Station. — The same treatment is entirely applicable at the South station, and would effect the same results in providing for a greatly increased traffic.

The existing loop and subsurface station, under the main floor level, has never been operated, and is not of sufficient capacity to provide for all of the rush hour suburban traffic at present handled at the station. Contingent upon electrification, however, and after effecting necessary grade separations at the entrance to the present yard, all Boston & Albany suburban traffic could pass under the New Haven tracks and into the present subsurface station for the discharge and loading of passengers.

This course would entail considerable expense, due to the necessity for grade separations, and result in no additional flexibility to the terminal transportation problem as a whole, as the project in question treats but one isolated point.

The best example of terminal station development on these lines is the installation now in process of construction at the Grand Central station in New York City. Here the suburban station platform and storage tracks and the loop are at the lower level, below the express train level. This depression was necessary on account of the necessity of carrying the cross streets, Forty-fifth to Forty-ninth streets inclusive, across railroad property between Madison and Lexington avenues at substantially the established street grades.

At the North and South stations, there being no cross streets to provide for, the suburban station tracks and loop could be elevated and thus occupy a level over the through express station. This course would be far less expensive than one requiring the construction of a depressed station, under the present operating level.

Although providing admirably for traffic conditions at each terminal as a unit in itself, the loop solution does not provide for the most enduring and flexible development in line with the entire terminal transportation problem.

Main Features of Proposed Development.

1. Differentiation of Four Classes of Traffic.

Any logical design for the development of properties should be based on the acceptation of certain fundamental requirements of traffic. To this end the following classes of service performed by the several lines of transportation within the terminal district are believed to be distinct in character, and a recognition of this distinction is made in the proposed ultimate development of the transportation system.

A. Through Express Traffic.

B. Suburban Traffic. — Comprising local service of the present steam lines, serving largely to carry the business and shopping population from suburban home stations, on express schedule, direct without change to a city station within five minutes' walk of actual destination, office, store or theatre.

C. Rapid Transit Service. — Comprising urban and suburban service, as performed by the elevated and subway divisions of the Boston Elevated Railway, — a distinctly local service, with multiple unit trains, frequent stations and but limited express service.

D. Street Car Service. — Whether performed on the surface or in the subways.

2. Impracticability of Joint Operation and Interchange of Equipment.

A. Distinct Class of Service. — Under the above differentiation, the two classes of service performed by the suburban and rapid transit systems of transportation are entirely distinct. The former implies express service from suburban stations ultimately 30 miles or more from the city proper, direct into a special distributing system in the city, where passengers may leave trains at one of several stations. The latter type of service, rapid transit, as the properties are constructed and operated at present, implies a convenient service from the near suburbs into the city proper, with frequent stations, trains making all stops and no express tracks or service.

B. Limited Clearances of Subway and Elevated Structures. — The permanent way clearances of the present elevated and subway structures are not sufficient to accommodate standard multiple unit equipment of the modern type for suburban service, a car approximately 10 feet wide by 60 feet long. Equipment of this type cannot be operated over the present rapid transit properties.

C. Types of Equipment. — The type of the present elevated and subway car, with side seats, center exit and end entrance, is perhaps the best general type for the service required, that is, for a system where the running time between terminals is limited, not so much by the speed between stations as by the rapidity of loading and unloading passengers at the frequent stations.

On the other hand, this type of equipment, which sacrifices the comfortable cross seats to the demands for the rapid handling of passengers at the stations, is not conducive to the comfort of patrons for a 30-mile run from the suburbs, where the schedule is limited rather by the actual speed of the train between stations than by the time consumed in loading and unloading at the comparatively infrequent stops.

Although at its inception the elevated and subway system might have been laid out and designed for the ultimate joint use of suburban and rapid transit traffic, the transition is considered impracticable and inadvisable to-day. Future subways or elevated structures should be designed as extensions to the present system, which should remain distinct to perform its important and characteristic service in the general system of distribution within the terminal district.

3. A Separate City Distributing System.

Any development which maintains the terminal features of the present system involves the transfer of all passengers at the terminal stations to some secondary distributing system. If a primary distributing system can be installed and operated, a greater number of passengers can be landed within easy walking distance of destination, without transferring to surface, subway or elevated lines.

Any new stations within the business center of the city which will serve all suburban trains will be of great benefit to a certain portion of the public who daily enter the city, and likewise reduce the number of passengers to be handled at the present stations.

Necessary Extensions and Revisions of Present Properties.

1. Subsurface Connection between North and South Stations.

It should again be noted that all suggestions for construction and operation are contingent upon the complete electrification of all lines entering the city, at least within the terminal district.

The need of through schedule, long-distance trains, from northern to southern New England points through Boston, and vice versa, is practically negligible so far as affording any argument for the construction of a connection between the two stations.

A. Terminal Features of Operation eliminated. — With a connection between the two stations, and all platform tracks in each train room leading into the connecting tracks, every train movement would become a forward or through movement, provided the locations of the present terminal yards for the storage, cleaning and turning of terminal equipment were transposed. That is, trains from the Boston & Maine system would proceed through the city and the South station into terminal yards on the New Haven property adjacent to South Bay. On the other hand, trains from the Boston & Albany and the New Haven systems would proceed to a terminal yard on Boston & Maine property north of the Charles River.

This feature is a fundamental requirement of the system it is proposed to develop.

(*a*) Transposition of Terminal Yards. — It is proposed to establish two new terminal yards for the care of all passenger equipment. These two yards will supplant the seven separate yards maintained and operated at present.

Property of the New Haven road at present undeveloped and lying under the waters of South Bay, located to the west of the Midland division main line, and to the north of Southamp-

ton Street, is ample in size to provide for the development of a terminal yard for Boston & Maine passenger equipment.

Property of the Boston & Maine road in Somerville, comprising areas lying between the main tracks of the Fitchburg and Western divisions, north of Prison Point bridge (now occupied, but which will be released under the development suggested above for freight traffic), together with a portion of the McLean Asylum parcel which adjoins the area above mentioned, and which, by the relocation of the Grand Junction Railroad, is susceptible of joint development therewith, is ample in size to provide for the development of a terminal yard for Boston & Albany and New Haven passenger equipment.

These several areas may be noted on drawing, Plate II., appended.

This recommendation toward the ultimate transposition of the present yards for the storage of passenger equipment is in no sense a radical suggestion, as it is eminently in line with the requirements for facility and economy in operation, and the reconstructed yards for electrified equipment would be the same whatever the identity of the equipment served.

(*b*) Operating Economies effected. — In addition to the economies which would be effected by the operation and maintenance of two terminal yards for passenger equipment, as proposed, instead of the seven yards which maintain under existing conditions, the present switching movements between the terminal stations and the terminal yards would be practically eliminated.

Under the present system of operation the road engines of many inbound trains cut off in the train shed, and, after unloading, the trains are pulled to the terminal yards by switch engines. In fact, a large number of engines are now maintained and operated for this distinct class of service, for movements between the train shed and the terminal yards.

Under the system proposed, providing for through movements, the road engine (electric locomotive or multiple unit train), inbound, would continue with its train to the terminal yards, and outbound, would pull the train from the terminal yard, no switch engine service being required.

As $12,000 per annum is a fair average cost for maintaining

and operating a single switch engine, the saving thus effected rapidly capitalizes permanent improvements to eliminate switch engine service.

B. Proposed Route. — (*a*) *Location.* — Several routes have been suggested and studied, having in sight the following conditions: —

Alignment and grades consistent with the demands of high-class traffic.

The desirability of providing for an additional station for suburban traffic only, between the North and South stations.

The advisability of avoiding, so far as possible, the existing subsurface structures of the subway system.

The desirability of avoiding the more expensive property in the business center of the city.

On account of the proverbial irregularity of the public thoroughfares in down-town Boston, it is futile to attempt to conform the alignment to the existing street layout, as this course could only be accomplished at the sacrifice of essential features of a railroad designed for a high-class traffic.

No attempts have been made to study possible changes in the layout of public thoroughfares which may be advisable along the route of the proposed connection, and which in many instances may be advantageously accomplished during construction.

The route proposed is indicated on the drawing, Plate II., appended. There is but one crossing of the present subway structures, namely, the East Boston tunnel in State Street, at Commercial Street. As a high-grade connection is suggested, this point of crossing over the East Boston tunnel becomes a limiting point in line and grade. It is the point farthest west where the subway structure of the proposed connection will pass over the East Boston tunnel structure at the required elevation below the surface of State Street.

Except for about 200 feet in Atlantic Avenue, the route is entirely independent of the city street layout.

(*b*) Alignment. — The alignment is easy and direct, the apparent offset at the North station being wholly unobjectionable, and in reality a part of the station layout.

Where the proposed route leaves Atlantic Avenue, at Broad Street, a curve of 500 feet radius is employed in order to avoid the property at the southwest corner, where these two thoroughfares intersect.

Between the proposed layouts at the North and South stations this connection is about 5,180 feet long, of which 4,350 feet are tangent and 800 feet curve.

(*c*) Grades. — The grades proposed are shown on the profile, Plate VII. The top of rail is level for the greater part of the distance at elevation — 7. Allowing for 16 feet vertical clearance above top of rail, and for a roof 30 inches thick, the top of the structure will be at elevation 11.5, or about 5 feet below the average surface of the streets crossed.

It will be noted on this profile that 5 per cent. grades have been employed for the approaches to the loops at the market station, and elsewhere for suburban traffic only. The radius of the proposed loops as drawn is 130 feet. These limits, while possibly extreme, are not inconsistent with the safe and expeditious operation of multiple unit trains, equipped with satisfactory motors and with radial draft gear.

(*d*) Foundations. — The outline of the original shore line is indicated on drawing, Plate II., appended. It will be noted that except for a distance of about 500 feet, in the vicinity of Hanover Street, the proposed route lies wholly outside of these limits. In fact, the present North and South stations are located entirely on made ground.

This fact will somewhat enhance the difficulty in obtaining suitable foundations for the proposed structures, but the construction problems to be met are such as to make this added requirement of but little moment.

(*e*) Construction below Tide-water Levels. — Throughout the entire length of the proposed connection, including the depressed train rooms at the North and South stations, the top of rail in the structures as proposed will be below elevation 0, mean low water, for a distance of 9,350 feet, and below elevation +10, mean high water, for 10,350 feet. It is obvious that the proposed structures within these limits must be designed to withstand the condition imposed.

(*f*) Property and Consequential Damages. — The private property crossed would be acquired in fee by the transportation company, but the subsurface rights only would be required, the aerial rights being subject to subsequent sale and independent development.

A four-track subway, with steel concrete side walls and space therein for cable ducts, with center supports between the two inside tracks, requires the occupation of about 60 feet clear width. A strip of this approximate width would be required across the basement areas of every building encountered.

(*g*) Traffic Capacity of a Four-track Connection. — The traffic capacity of the system proposed is entirely dependent upon the number of train movements which, during rush-hour service, may, within safe limits, be operated through the connection. The ultimate effective capacity of a four-track connection is outlined below.

The operating interval allowed between trains, together with the time allowed for loading and unloading at the station, will determine the consistent number of platforms required at intermediate stations.

The electric automatic lap block signal system, as at present designed, installed and operated on several subway systems to-day, for the control of train movements of frequent interval, together with modern brake equipment, will, with entire safety, permit of an operating interval between trains, at speeds up to 20 miles an hour, of forty-five seconds per track. Based on an average speed of 20 miles per hour, about 30 feet per second, an operating interval of forty-five seconds is equal to a distance of 1,350 feet, or ¼ of a mile.

Assuming this forty-five second train interval per track as a basis of figuring, and assuming for the moment that during rush hours all tracks are available for suburban traffic exclusively, the interval between trains for traffic in one direction would be twenty-two and one-half seconds, and for traffic in both directions eleven and one-quarter seconds.

Based on 8 60-foot car suburban trains, a seating capacity per car of 72, the capacity of each train would be 576 passengers. With a train from the suburbs every eleven and one-

quarter seconds, 320 trains and in round numbers 184,000 passengers would enter the city every hour.

The above result is obviously theoretical, and in figuring a practical maximum schedule due allowance must be made for interruptions due to necessary cross-traffic movements, the necessary use of two tracks through the connection for some through express train movements during rush hours, and the loading of some trains below capacity.

Making an allowance for actual efficiency of 50 per cent., the operating interval between trains in one direction becomes forty-five seconds, the total number of trains an hour becomes 160 and the total number of passengers per hour 92,000, in round numbers.

There are approximately twelve main lines and branches entering trains in each direction. Based on an actual operating interval through the connection of forty-five seconds for trains in each direction, each main line and branch would enter a train, on the average, every nine minutes.

The above data tabulates as follows: —

Traffic Capacity, Four Tracks.

Interval between trains, one direction, per track, forty-five seconds.

Interval between trains, one direction, two tracks, twenty-two and one-half seconds.

Interval between trains, both directions, four tracks, eleven and one-fourth seconds.

Average speed, 20 miles per hour = 30 feet per second.

An interval of forty-five seconds = 1,350 feet = ¼ mile.

Suburban trains, 8 60-foot cars.

Seating capacity per car, 72.

Seating capacity per train, 576.

One train every eleven and one-fourth seconds = 320 trains per hour.

320 trains per hour = 184,000 passengers per hour.

Allowing 50 per cent. efficiency.

Interval between trains, one direction, per track, ninety seconds.

Interval between trains, one direction, two tracks, forty-five seconds.

Trains per hour, both directions, 160.

Passengers per hour, both directions, 92,000.

Under "Passengers handled," above, we derived a maximum burden for rush-hour traffic via the present steam lines of

23,000 passengers per hour in 1908. Figuring on a 25 per cent. rate of growth applied in ten-year periods, the ultimate capacity of a four-track connection will be reached in 1965.

A more or less complex system of grade separations, where the several divisions or lines converge to enter the proposed city distributing system, would eliminate most cross-traffic movements and correspondingly increase the capacity of the systems. Such a course should be fully considered in connection with more detailed studies for the proposed development.

2. Development at South Station.

A. Depressed Train Room. — (*a*) Plan. — As brought out above, in order to render the proposed development thoroughly effective all platform tracks, both at the North and South stations, should ultimately lead into the connecting tracks, so as to render possible through movements from every platform track.

In the tentative track layout adopted, 1 : 3 ladder angles and No. 7 frogs have been employed. The arrangement of tracks and platforms in the depressed train room at the South station, comprising a width of about 450 feet, provides seventeen tracks for through express trains, with alternate passenger and baggage platforms, 17 feet and 11 feet wide, respectively, serving each track on opposite sides. The effective capacity of these seventeen tracks against platforms are: —

Minimum capacity, 6 80-foot cars.
Maximum capacity, 13 80-foot cars.
Average capacity, 10 80-foot cars.

In addition to the platform tracks for through express service, there has been provided a separate group of platform tracks for suburban service. For this service the high platforms, level with the car floor, are recommended, and a platform width of 15 feet has been adopted.

It will be noted on the drawing, Plate II., appended, that the platforms for suburban service are located at the northerly end of the layout, so that quick egress to Summer Street is possible.

(*b*) Grades. — The tentative grades adopted in connection with the study may be noted on the profile, Plate VII., appended. As it is undesirable to raise the present surface of Summer Street, the point of crossing under this thoroughfare becomes a limiting point to the grade. A grade of +.2 of 1 per cent. southbound has been adopted for the tracks through the train room.

This grade is employed to the southerly neck of the yard, at the point where the platform tracks converge, where the approach grade of +2 per cent. southbound begins and continues to an intersection with the present track grades.

The grade of .2 per cent. employed through the station, while not so desirable as a level grade for platform tracks, is not seriously objectionable, and is essential to the layout, an elevation of about 3 feet being gained thereby at the south end of the yard.

The 2 per cent. approach grade is also entirely consistent with the unit of propulsion for electric service.

(*c*) General. — Under the tentative scheme, the new passenger concourse, from which stairways would lead down to the passenger platforms, would be at substantially the same grade as the present concourse. The baggage concourse, from which elevators would descend to the baggage platforms, would extend over the tracks, between the present outbound and inbound baggage rooms, at about the present floor level of these rooms. Baggage to and from local points within the suburban district would be handled by trains entering and leaving from the through express tracks.

United States mail matter would reach the baggage platforms from the mail rooms, via the baggage concourse and elevators.

The facilities of the express companies would be reached from Atlantic Avenue, as at present, but the new development should be entirely south of Kneeland Street, between Cove Street bridge and the main tracks, at a grade somewhat below the present grade of Atlantic Avenue.

The grades proposed for the tracks through the station provide sufficient vertical clearance above the tracks to permit of the extension of Kneeland Street across the layout at substantially a level grade, to an intersection with Mount Washington

Avenue bridge. As this procedure may become desirable in the future, designs of contiguous structures should be carried out with this end in view. By keeping the layout for express business to the south of Kneeland Street, the express building will not interfere with this possible extension.

The space occupied by the train shed, above the concourse or ground floor, might ultimately be developed into offices for rental.

A portion of the platforms at the south end of the layout would extend beyond the superstructure of the station building, and should be protected by canopies. The present station building, head house and wings would be maintained essentially as at present.

B. Non-availability of Present Loop and Subsurface Station. — As indicated on the profile, Plate VII., appended, the elevation of the tracks of the present subsurface station and loop are about 7 feet above the grade of the tracks in the proposed train room. It will be impracticable to utilize in the proposed development any features of the existing subsurface structures.

3. Development at North Station.

A. Depressed Train Room. — (*a*) Plan and General Features. — The tentative layout for the through express and for the suburban platforms and tracks is indicated on the drawing. The general features are the same as at the South station, with such changes in the form and location of the several groups of tracks as are necessary to meet the local conditions.

The same provision is made for suburban service as at the South station, the platforms for this service being located near Causeway Street in order to permit of quick egress to the street.

Baggage and mail matter would be handled as suggested for the South station. That portion of the express business at present handled in the east wing of the station, with entrance from Warren bridge, would be removed to a new area of tracks and platforms developed at approximately present street grades, west of the proposed station layout and north of Minot Street, with entrance from Minot Street.

This change is advisable on account of the proposed relo-

cation of the Union Freight Railroad tracks parallel to, at the same grade as and immediately east of the easterly track of the station layout. Thus all express cars from the present area adjacent to Warren bridge would have to be switched across both tracks of the Union Freight Railroad to reach the platform tracks in the station.

The capacity of the through express platform tracks provided at the North station are: —

Eighteen tracks: —
Minimum capacity, 4 80-foot cars.
Maximum capacity, 12 80-foot cars.
Average capacity, 10 80-foot cars.

(*b*) Grades. — As it is inexpedient to raise the present surface of Causeway Street, the grade of this thoroughfare becomes a limiting point to the grade adopted. The grades employed correspond to those at the South station, viz., through the station, +.2 of 1 per cent. northbound, and for the approach 2 per cent., which is the least grade — crossing under the present grade of Causeway Street — that will permit of the extension of the platforms north practically to the proposed southerly bulkhead line, and reach a draw opening sufficiently far from the northerly bulkhead line of the Charles River.

It will be noted on the drawings, plates II. and VII., appended, that the drawbridge opening in the Charles River is removed from its present location, near the south side of the river, northerly about 875 feet, to a new position near the north bulkhead line. This course is a fundamental necessity for the tentative development proposed. In fact, it is impossible to maintain the draw opening in its present location, and, at the present or a higher grade, reach a subsurface connection under the present grade of Causeway Street, and develop a station layout on the site of the present North station.

(*c*) Alternate Approach Grades, United States War Department Recommendations. — Under "Removal of North Station to the North Side of Charles River," above, alternate suggestions were outlined. On the profile, Plate VII., appended, will be noted approach grades, employing the adopted

limiting grade of 2 per cent., corresponding to the five extreme conditions, any one of which will force the location of the North station to the north side of the Charles River, as follows: —

AA. — Tracks raised at the crossing of the Charles River, from present grade of about 17.5 to grade 37, to provide 23 feet clearance for river traffic, as recommended by the War Department. Drawbridge located as at present.

BB. — Tracks raised as under AA, but drawbridge moved to point near the north bulkhead line of the river.

CC. — Elevation and location of drawbridge maintained as at present.

DD. — Entrance by the tunnel under the river, providing 20 feet (consistent with allowable draft of 17 feet through the lock in the new Charles River dam) between mean low water and the tunnel roof. This would bring the elevation of tracks in the tunnel at elevation about —44. Drawbridge located as at present.

EE. — Entrance by tunnel, and track grades as under DD, but drawbridge moved to a point near the north bulkhead line of the river, as under BB.

The several grade lines described are illustrated on the profile, designated by notations corresponding to the paragraph headings AA, BB, etc.

As above stated, the location of the North station on the north side of the Charles River is believed to be entirely inconsistent with the best development of the transportation system as a whole.

B. Change in Southern Division Alignment. — Under "Connections — between Clearing Yard and Local Delivery Yard," above, a suggested change in the alignment of the Southern division was outlined. This revision enters Southern division traffic, south of Prison Point bridge, parallel to the other three divisions of the road.

The proposed alignment is indicated on drawing, Plate II., appended.

C. New Railroad Bridge across Charles River. — It is proposed to construct, as a part of the suggested development, one new steel concrete railroad bridge across the Charles River to

carry all the present lines of steam railroad traffic now crossing the river by the four pile and timber trestles. This new bridge would make possible the removal of the four existing bridges, and leave but one bridge between Warren bridge and the new Charles River dam.

The location of the proposed bridge may be noted on the drawing, Plate II., appended, its center line corresponding closely to that of the present main bridge into the North Station.

Incorporated in its section would be ten tracks, as follows: —

On the west side, one freight track, to serve as an entrance to the Minot Street local delivery yard.

Next, six tracks for passenger traffic.

Next, two tracks for Union Freight Railroad.

On the east side, one freight track, to serve as an entrance to the Warren bridge local delivery yard.

The two freight tracks, one on either side, would cross the structure on level grades, conforming substantially to the present grade, at elevation about +17.5. The intermediate eight tracks, including the six passenger tracks and the two for the Union Freight Railroad, would descend on a 2 per cent. grade from the new drawbridge, inside the proposed structure, as shown on the profile.

It will be observed that the proposed bridge between the new draw span and the south bulkhead line of the river is in reality but a section of the proposed southerly bulkhead, — the two freight tracks being immediately inside the parapets of the bulkhead, and the eight intermediate tracks descending between the two parallel bulkhead walls.

From the draw span to the north bulkhead line the structure would be a bridge of several spans, about 175 feet long.

This proposed restriction of the present free water way will not cause any appreciable current even during flood discharge. The Charles River dam has been designed and constructed providing for a maximum river flood discharge of 6,000 cubic feet per second; including its draw opening there will be about 200 feet of free water way under the proposed bridge, exclusive of piers. With the established low-water channel depth of 17 feet, the velocity of flow under the most extreme condition will

be less than 2 feet per second, or only about 1½ miles per hour.

There will be at all times about 150 feet of waterway for the passage of craft not requiring the draw opening, adjacent to the northerly bulkhead line of the river. The center line of the proposed drawbridge would be about 200 feet from the bulkhead.

This necessary deflection of all river traffic from the Warren bridge draw, across the river to the draw in the proposed railroad structure, and back again to the lock in the new dam, while apparently illogical, in reality offers no additional hazards to river traffic, on account of the free open basins between the structures (a condition that will be realized by the removal of the present pile bridges) and the absence of currents since the completion of the dam.

D. Changes in Charles River Bulkhead Lines. — Although the southerly harbor line of the Charles River, as established in the vicinity of the North station, lies considerably shorewards from the channel, the effective harbor or bulkhead line, except opposite the Minot Street freight yard, is defined by the present channel limits, or by the draw openings.

The location of the southerly bulkhead line, as proposed, between Warren bridge and Charles River dam, is indicated on the drawing, Plate II., appended. This line follows the actual bulkhead immediately west of Warren bridge, intersects the southerly abutments of the present draw spans of the three easterly pile railroad bridges, and then swings by a curve to a point on the new dam about 100 feet south of the ship lock.

This suggested relocation of the southerly bulkhead line makes available certain areas now under water, both west and east of the station layout, for increasing the area and capacity both of the Minot Street and the Warren bridge local delivery freight yards. The river areas thus appropriated are entirely ineffective as accessory to river traffic, and their introduction into terminal property as land areas renders possible a practicable development of the two local delivery freight yards, as served from the freight tracks crossing the river on either side of the new bridge.

The northerly bulkhead line, between Warren bridge and the

new dam, is maintained substantially as constructed at present, except in connection with suggested changes in the entrance to Miller's River, which will be discussed below.

The design of the new bulkheads should be in harmony with the proposed railroad structure across the river, and no provisions need be made for wharfage uses, as the bulkheads are contiguous to railroad property developed entirely for other purposes.

The marked improvement of the Charles River in the vicinity of the North station which will result from the realization of all the suggestions outlined can hardly be magnified.

In view of this eminently satisfactory treatment, rendered possible by a joint development of the river basin with the transportation properties, whereby one modern structure supplants four disreputable pile trestles, and three drawbridges are eliminated entirely, it is thought entirely probable that the recent decision of the War Department, approving the report of the special Board of Engineers appointed to investigate the condition of the Charles River in the vicinity of the North station may, upon request, be reconsidered. This report recommended the raising of the present railroad bridges to provide 23 feet clear headroom for river traffic above mean high water, which recommendation, as brought out above, is entirely inconsistent with any satisfactory development at the North station.

E. Changes in Miller's River. — The treatment of the northerly bulkhead line is entirely contingent upon the future of Miller's River. If this water way is to be maintained permanently, provision should be made, if possible, to have the new drawbridge in the proposed railroad structure across Charles River serve as well for vessels destined to Miller's River. This will eliminate one drawbridge in the main tracks where Miller's River crosses at present.

To effect this elimination of one break in the main tracks, a new channel must be dredged from the Charles River immediately west of the proposed railroad bridge, parallel to the tracks a distance of about 900 feet, to a point in Miller's River just east of the Prison Point bridge, as indicated on the drawing.

On the other hand, if the industries now located on this

water way in time should rebuild or move to advantageous sites on the immediate water front, Miller's River may be filled and appropriated for railroad uses. This filling may be prosecuted with economy by utilizing the material which will become available as the high ground on the McLean Asylum parcel is gradually graded down for the extension of railroad terminal facilities.

In line with this possibility of the ultimate disuse as a water way and the subsequent filling of Miller's River, the present entrance from Charles River, as well as the present draw-bridge, should be maintained.

In either event, the northerly bulkhead line between the new railroad bridge and Warren bridge ultimately becomes continuous, and the present channels to Miller's River, lying easterly of the main tracks, may be filled, and these areas appropriated for increasing the facilities of the Warren bridge local delivery yard in Charlestown.

F. North Station for Rapid Transit Traffic. — In connection with the design for improvements at the North station no attempt should be made to retain all or any part of the present station superstructure. A new edifice should be designed and erected coincident with the track changes.

The new superstructure should also house on the second floor tracks and platforms for rapid-transit service, designed to provide for direct transfer between the trains of the several routes of the rapid-transit system and trains of the suburban system. From the main passenger concourse of the new station stairways should lead up direct to the platforms of the rapid-transit station.

No elevated structure should be erected in Causeway Street. The route that is proposed to cross the new dam should pass through the new station superstructure, as above suggested.

4. Proposed "Market Place" Station.

In connection with the proposed subsurface line connecting the North and South stations, it is proposed to construct, in the market district, between Hanover and State streets, a station for suburban traffic only. The location of this proposed station is indicated on the drawing, Plate II., appended.

In the tentative design, two groups of platform tracks are provided, one for traffic in each direction, each comprising two platform tracks in addition to the main suburban track, which also has platform service. The general design of the layout is similar to those for suburban service at the North and South stations, the effective length of the platform tracks providing for 8 60-foot car trains.

The station would be entirely a subsurface structure, consisting only of tracks and platforms. The only superstructure necessary would be suitable housings for entrance and exit, and for a ticket office. No waiting room or other accessories would be necessary.

5. Improvements at Back Bay Stations.

Under present arrangements, the Boston & Albany Railroad has but three main tracks between Columbus and Huntington avenues, with two side platforms, one for inbound trains at Huntington Avenue station, and one for outbound trains at Trinity Place station. Simultaneous platform service is limited to one train in each direction.

With a continued growth in traffic, it will soon be absolutely necessary, in order to insure adequate service at this point, to supply this missing section of fourth main track, and to provide additional platform space for the simultaneous service of two trains in each direction.

Such a layout is possible on present Boston & Albany property, but to effect this result the present Trinity Place and Huntington Avenue stations must be moved back, or abandoned and torn down. The latter course is recommended, together with the joint use of the present Back Bay station with the New Haven road.

By utilizing the additional width rendered available by abandoning the present stations, a fourth main track may be constructed, and easy swings in the tracks encompassed to provide for two "island" platforms, each serving, under present traffic arrangements, one inbound and one outbound train.

East of the present Dartmouth Street bridge, issuing from a convenient point in the Back Bay station, and at a grade level with the present floor of the station, an overhead bridge or

concourse would cross the tracks, and from it passenger and baggage lifts and stairways would lead to the two new platforms. Exits direct from the platforms to Dartmouth Street and to Huntington Avenue would also be desirable. The proposed bridge should, of course, be suitably housed and the platforms protected by canopies, so that patrons may remain under cover from the waiting room to the platform.

The floor space in the present Back Bay station is in all respects ample to provide comfortably for all traffic on both lines for years to come, and the arrangement of space, with certain modifications to provide for reaching the waiting room and baggage room from the proposed bridge, is well suited to joint occupation.

In connection with all designs for improvements at this point, the desirability of replacing the present unsightly Dartmouth Street "through" bridge with a "deck" structure should be borne in mind, and provisions made for foundations for intermediate supports.

6. Additional Suburban Stations in the Back Bay District.

As the business center of the city gradually moves southwest along the axis of the peninsula, coincident with the general growth of the community, and as certain sections of the Back Bay district are gradually transformed into business communities, additional stations for suburban service will be desirable at Massachusetts Avenue, both on the New Haven and the Boston & Albany lines.

7. Development of Boston, Revere Beach & Lynn Railroad.

The Revere Beach road should ultimately be reconstructed on a standard-gauge basis, electrified, extended into Boston proper via a double-track tunnel under the harbor, to a connection with the proposed subsurface line between the North and South stations just south of the proposed market place station, and operated as a unit in the general suburban transportation system of the terminal district.

After the gauge of the road is made standard, freight delivery to points on the line in Winthrop and Revere will be

possible direct from the proposed clearing yard, via the Grand Junction Railroad and proposed connections near the northerly limits of East Boston. Thus these two communities will enjoy the advantages of direct rail freight deliveries, — a privilege denied them under the present system.

After electrification, it will be possible to operate a tunnel under the harbor. The northerly approach — a continuation of the present tangent north of Maverick Street, in East Boston — would begin its descent from the present grade, at a point north of this thoroughfare, and pass under the present grade of the street. The Boston approach would extend down Milk Street and under Central Wharf from the proposed loop under the connection between the North and South stations.

The location of the proposed tunnel is indicated on the drawing, Plate II., appended.

The present location of the Revere Beach terminal on the water front of East Boston, immediately east of the Boston & Albany Railroad terminal, is a complete barrier to the continuous and systematic extension and development of the water front for railroad terminal purposes, as may be necessary to meet the future demands of traffic. Upon the opening of the proposed tunnel for operation, the present terminal grounds may be abandoned, making possible a direct extension of the system of docks for railroad terminal purposes.

As a logical development of the terminal transportation system requires a more or less strict adherence to the traffic differentiation above outlined, it would be inadvisable to provide in Boston a separate terminal station for Revere Beach traffic. Traffic from this line should ultimately enter the one distributing system proposed for suburban traffic, whatever may be the initial and subsequent stages towards this final state of completion.

8. Operating Flexibility of Proposed System.

The installation of two single track loops, matters of comparatively small expense in themselves, at either end of the proposed market place station, crossing under the four main tracks of the connection, one in Hanover Street and the other in

connection with the Revere Beach junction, as indicated on the drawing and profile, plates II. and VII., appended, will provide for through movements of trains in any direction. Not that such a course is an immediate necessity, but at a comparatively slight additional expense, if prosecuted with the construction of the proposed connection, features are installed which provide for any contingency of this nature which may arise in the future.

Trains from New Haven or Boston & Albany territory unload at the South station and the market place station, and may then proceed to the North station and Boston & Maine territory, or, via the loop, proceed to the Revere Beach line or return to the South station. Corresponding movements are possible by trains from Boston & Maine territory.

The lines and branches at present serving suburban districts are considered adequate. Electric operation may, however, develop certain missing links which it may be desirable to supply in order to provide for circuit movements.

9. The Development of Transfer Stations between Suburban and Rapid Transit Systems.

Where present or future subway or elevated stations are contiguous to the stations of the suburban distributing system of the city, as proposed, joint study should be given to the development at such points, with a view to providing a convenient and direct means of transfer from one system to the other.

Such a problem was mentioned in connection with the proposed development at the North station, where the new station edifice should house the North station of the rapid transit system, and one other point should be mentioned, at the South station, in connection with any future subway which may be constructed to or past this point.

The Proposed Boston & Eastern Electric Railroad.

As proposed, the Boston & Eastern Electric Railroad is designed for high-speed suburban traffic, providing express service from territory lying as far as 30 miles from the city proper. Obviously this implies suburban traffic as outlined in the dif-

ferentiation of the several classes of service, and the proposed line should ultimately utilize the suburban distributing system proposed for the city proper.

If the project is to be realized in the near future, temporary terminal arrangements should be provided in Boston, so far as possible in connection with existing facilities, to the ultimate end above mentioned.

It is furthermore eminently desirable that all future passenger lines within the terminal district, which may be authorized by the Commonwealth, should enter one or the other of the city distributing systems, as these systems may be improved and extended; namely, the rapid transit system or the suburban system. The best public service would not result by the operation of future lines to independent terminals within the city.

One double-track tunnel under the harbor would serve to enter both the Revere Beach road and the projected Boston & Eastern Railroad into the proposed suburban distributing system of the city proper. It would seem an unwise expenditure to provide separate tunnels, — a course which would result in an unwarranted duplication of items of great expense. Before the plans of the projected road receive final approval the joint project of entering the two lines should receive a thorough and exhaustive study.

As the electrification of the present lines becomes urgent, in order to meet increased traffic requirements, as well as to render possible the operation of subsurface facilities in the city, this change in motive power will be gradually realized. Coincident with the prosecution of work entailed in this change of motive power, physical revisions and improvements of the existing railroad properties in the way of four tracking, grade crossing elimination, additional stations, etc., will be carried on.

In the ordinary course of events, under conservative management these improvements will be carried on only as warranted by the traffic, not necessarily as it exists, but in anticipation of a more or less rapid growth. The construction of any new lines parallel to existing roads, and serving the same territory, unless warranted by traffic requirements, will defer the date when improvements upon existing lines may be justified.

IV. WATER FRONT DEVELOPMENT.

General Analysis.

An analysis of the factors which must be considered as having an important bearing on the question of new docks along the various water fronts of Boston is perhaps a pertinent preface to any remarks outlining a suggested layout for the docks themselves.

Primarily, docks and wharves with their allied features serve to facilitate the transshipment of goods and passengers from inland to maritime carriers and *vice versa*. The transshipment facilities at the water front are but links in the various chains of transportation.

Export and outbound coastwise tonnage for purposes of analysis may be divided into two classes, depending on the origin: —

Long-haul tonnage: goods from some considerable distance, entering the port on one of the trunk lines.

Short-haul tonnage: goods and manufactured products, created in the vicinity of the port.

In most instances the dominant factor is the long-haul tonnage, and in consequence we find the several systems of docks and wharves at the terminals of the trunk lines. Short-haul tonnage reaches these docks by main line or branch tracks, or sometimes by private tracks.

Occasionally, however, we find an industry or group of industries of manufacturing and warehousing interests whose combined output utilizes largely one or more lines of vessels. In this event the short-haul tonnage dominates, and long-haul tonnage, destined for transshipment in these vessels, must reach docks located primarily to serve the local industries.

In short, the transportation companies at present dominate the situation as regards the development of water-front facilities for the handling of long-haul tonnage, and, as a rule, of short-haul tonnage as well.

During the formative period of our railroads, each independent line sought to have its own water-front facilities at the seaport. As combinations of the inland transportation lines were effected, water-front terminal features were merged when

possible. As these combinations continue, and further operating flexibility is made possible, the docks and wharves of the immediate future should, where feasible, be located at the foci of the several entering trunk lines. When all the available water front which may consistently be developed to serve the trunk lines as they enter the port to-day is utilized, it may then be necessary to construct additional railroad connections from the main line tracks to new and undeveloped stretches of water front, outlying further from the center of the port.

This contingency alone will force the consideration of Quincy Bay, Old Harbor or Lynn harbor as possible marine terminals for the trunk lines entering Boston at present. As it is possible to develop on the flats at South and East Boston piers 1,200 feet in length, having an effective frontage of about 25 miles, this contingency seems too remote to warrant further consideration at this time.

The absolute necessity of harmonizing the interests of the transportation lines with any scheme for water-front development for the transshipment of tonnage must be apparent. In the continued idle condition of the Commonwealth Pier at South Boston, we have evidenced the natural result of water-front development on lines independent of the interest of the inland transportation companies.

There is, however, the possibility that an industrial center or district may be developed on the water front, similar in extent of operation to that of the Bush Terminal Company at Brooklyn, N. Y. Such an enterprise would be largely self-contained, and to that extent independent of the transportation companies. The docks in connection with such an enterprise would primarily serve for the handling of raw materials and finished products of the industries at the docks. They would not be a part of any transportation system, but allied rather to the creation of the tonnage.

Present Development.

1. Railroad Terminals.

A. Hoosac and Mystic Wharves of the Boston & Maine System. — The present facilities of the Boston & Maine Railroad, the Hoosac Docks of the old Fitchburg Railroad and

Mystic Wharf of the old Boston & Lowell Railroad lack any possibilities of further development for vessels of large tonnage.

The area of the present Hoosac Docks is entirely confined, and the effective width between harbor lines of the Charles River at this point is only about 650 feet. The area of Mystic Wharf, except above the Chelsea Street drawbridge, across the Mystic River, is also strictly confined.

It is believed as effective water-front facilities for vessels of heavy tonnage are increased at East and South Boston that the use of the Hoosac and Mystic wharves will be limited to vessels of smaller tonnage for coastwise traffic.

It is inevitable that the Boston & Maine management will soon be confronted with the necessity of selecting a new site for modern docks, to accommodate vessels of heavy tonnage. Under a proper arrangement with the New Haven management, Boston & Maine traffic can in part be diverted to marine terminals at South Boston, either by means of car floats plying from Mystic Wharf, or direct by rail, the diversion taking place at outlying junction points.

With the railroad terminal situation still further unified, the water frontage at East Boston would be available for Boston & Maine tonnage, via the Grand Junction Railroad, from the proposed clearing yard.

B. East Boston Terminal of the Boston & Albany Railroad. — Since the recent disastrous fire which destroyed a large part of the East Boston terminal property of the company, the Boston & Albany Railroad has begun the construction of new piers, Nos. 3, 4 and 5, having a length of about 800 feet. The immediate development utilizes the entire holdings of the railroad between Marginal Street and the established exterior pierhead line, — a width of about 1,075 feet. The resulting condition of piers Nos. 1, 2, 3, 4 and 5 is indicated on drawings, plates II. and III., appended.

C. South Boston Terminal of the New Haven System. — As was indicated under "Tonnage Data" above, the New Haven road handles comparatively no export or import tonnage at the port of Boston.

The existing railroad piers, Nos. 1, 2 and 4, as indicated on

drawings, plates II. and III., appended, vary in length from 900 to 1,100 feet.

The considerable land holdings of the New Haven at Squantum flats, on the Plymouth division, could be developed into marine terminals for the entire port tonnage of the system should South Boston at any time in the future become untenable. A connection about half a mile in length, from the Midland division, near Rugby station, to Mattapan station, on the Mattapan branch, would give feasible access to this property for traffic, both from the Providence and Midland divisions.

2. Miscellaneous.

A. Westerly Front of East Boston. — Between the Boston & Albany holdings and Meridian Street bridge, a distance of about 7,000 feet, the width for water-front development from Border Street to the established exterior pierhead line is about 900 feet.

Although the docks and wharves throughout this stretch present no semblance of regularity, in their present condition considerable traffic can be handled. As in the case of Chelsea Creek frontage, the realization of the East Boston Railroad project, which will provide direct rail service to the piers, is believed to be essential to any continued activity in this locality.

B. Mystic River and Chelsea Creek. — All vessels destined to these water ways must pass through the Chelsea Street (Charlestown) or the Meridian Street (East Boston) drawbridge.

Between the present Mystic Wharf and Malden bridge, a distance of about 3,800 feet, the southerly front of Mystic River is subject to development for handling coastwise vessels of limited draft, with rail service direct from the proposed clearing yard via the Mystic Wharf Branch.

Between the present Meridian Street and Chelsea Street bridges, from East Boston to Chelsea, a distance of about 5,500 feet, the water front along the southerly shore of Chelsea Creek, formerly more or less active, has become practically dormant.

Should the projected East Boston Railroad be realized, this stretch of water front will have rail service direct from the

proposed clearing yard, and will become more important for coastwise traffic and for manufacturing purposes.

C. Charles River, Miller's River, Broad Canal, Lechmere Canal, Fort Point Channel and South Bay. — It is believed that the future will see no appreciable increase in shipping via these water ways, and, furthermore, with the exception of Charles River and of Fort Point Channel as far south as Dorchester Avenue bridge, that they will grow into gradual disuse as local industries and other enterprises seek more advantageous locations on the water front, where direct rail service will be available as well.

In view of the tonnage that is at present handled along Albany Street via Fort Point Channel, through nine drawbridge openings to South Bay, the possibility of the complete disuse of this stretch of water front may seem very remote. Notwithstanding this fact, however, it is believed that Fort Point Channel and South Bay south of Dorchester Avenue bridge will ultimately be abandoned for shipping purposes, and these areas given over to land developments.

D. Atlantic Avenue. — The present condition of the Atlantic Avenue water front of Boston proper was discussed briefly under "Improvements of Union Freight Railroad." The future development suggested will be taken up below.

Future Development.

1. Railroad Terminals.

In line with the above brief general analysis, the present terminals of the New Haven and Boston & Albany roads are well located, and any development for future railroad terminal docks should be designed and constructed as extensions of the present facilities.

By virtue of its location, with direct access to Boston proper, South Boston has a distinct advantage over East Boston as a site for a marine terminal. The construction problems will be practically the same for both localities.

The enactments permitting the control of the Boston & Albany to pass to New York Central interests compelled certain improvements by the Boston & Albany Railroad for the purpose

of eliminating grade crossings along its Grand Junction line through East Boston. These improvements have recently been completed at an expense to the railroad company of upwards of $1,000,000. Coincident with the grade-crossing eliminations the railroad has improved its track layout and increased its car-storage space, the entire construction being of a permanent nature.

In view of these improvements recently completed, together with those now being prosecuted in the way of new piers, the permanency of this location seems well established for the immediate future.

Whatever may be the secondary stage in the development, it is eminently desirable to adopt at the outset some effective plan for the ultimate development of all areas that are available within practicable limits, to serve as a working basis for any future extension that may be necessary to meet traffic requirements.

A. East Boston Flats. — The existing barrier to any extension of the present Boston & Albany terminal docks, the terminal grounds of the Boston, Revere Beach & Lynn Railroad, will be removed when the Revere Beach road is extended under the harbor and into the suburban passenger system of the terminal district, as suggested.

The small docks, at present located between the Revere Beach terminal and the easterly end of the southerly water front, must gradually give way to new docks and wharves as railroad terminal facilities are extended. The development is a direct continuation of present features, there being no idle property or gaps to be traversed before reaching new dock sites.

The ultimate development suggested is indicated on drawing, Plate III., appended. The peninsular development appropriates practically all of Noddle Island flats, the recently acquired holdings of the Commonwealth in East Boston, a small portion of the flats owned by the city off Wood Island Park and the present channel north of Bird Island flats.

The proposed southerly exterior pierhead line extends almost due east from the present angle in the established exterior line south of the Revere Beach terminal along "Governor's Island Channel." The channel limits are also indicated. As drawn,

the piers are in the main 1,200 feet long and 250 feet wide, with slips 300 feet wide.

Under a still more comprehensive development the peninsula might be extended southeasterly to incorporate the area included in Apple Island flats, which are owned by the city, without in any way detracting from the needs of the harbor for shipping purposes. The present easterly exterior harbor line is indicated on the drawing, Plate III., appended. The approximate outlines of the following parcels are also indicated, property of the Commonwealth being denoted by crosshatching: —

Property.	*Owned by*
Wood Island Park and flats,	City of Boston.
Apple Island flats,	City of Boston.
Flats recently acquired,	Commonwealth.
Bird Island flats,	Commonwealth.
Small area of flats west of Apple Island flats,	Commonwealth.
Governor's Island and flats,	United States government.
Noddle Island flats,	East Boston Land Company or Commonwealth.[1]

All of the flats north of the Wood Island Park property of the city, in the bay between East Boston, Breed's Island and Winthrop, are held by private ownership.

B. South Boston Flats. — East of the property of the New Haven road and north of Summer Street, between the established northerly pierhead line and the channel extending westerly from the main ship channel north of Castle Island, the flats and property are all owned by the Commonwealth. Certain parcels south of Summer Street are also owned by the Commonwealth, all as indicated by crosshatching on drawing, Plate III., appended.

The development indicated is but the natural extension of the pier frontage easterly from the present Commonwealth Pier to an ultimate development of all the property in question. As in the layout suggested for East Boston, the piers are in the main 250 by 1,200 feet, with slips 300 feet wide.

[1] Question of ownership now before the courts.

C. Independent Routes formerly suggested to reach South Boston Flats. — In former years the desire to render the Commonwealth flats at South Boston available for the development of terminal facilities for a railroad handling a considerable amount of tonnage requiring transshipment led to recommendations as to various routes for the purpose of diverting traffic from the Fitchburg Railroad to South Boston. As these recommendations for independent action, advanced thirty years or more ago, were not realized, and in view of the entire change in the relation of the railroad managements which has been effected since that time, the routes proposed may be mentioned merely as matters of passing interest.

In 1873, embodied in the "Report of the Committee in relation to the Use of the Commonwealth Flats at South Boston," H. F. Keith, engineer, and again in 1879, embodied in "Memoranda in regard to the South Boston Docks and Flats and the Proposed Junction Railroad thereto," by Edward Atkinson, E. S. Philbrick, engineer, routes were proposed from a junction with the Fitchburg Railroad near Roberts or Stony Brook stations, across the towns of Newton and Brookline, and through Forest Hills and Dorchester by independent routes to South Boston. Even were a connection along this general route desirable, the present state of development of the territory encompassed makes such a project wholly impracticable.

D. Existing Outer Connecting Line. — On the railroad map, Plate I., appended, may be noted an existing outer belt line, connecting all main trunk lines entering the port except the Eastern division of the Boston & Maine and the Plymouth division of the New Haven. This route comprises the Lowell branch, Western division, Boston & Maine Railroad, and the Lowell and Fitchburg branches, Taunton division, New York, New Haven & Hartford Railroad.

The relative distances to East Boston via the proposed clearing yard and the Grand Junction Railroad, as compared with the corresponding distances via existing all-rail connections to Medfield Junction, and thence via Needham Junction, West Roxbury, Dedham and Readville to South Boston, are approximately as follows: —

Relative Distances.

	Traffic from —	Miles to South Boston via Existing Lines.	Miles to East Boston via Proposed Clearing Yard and Grand Junction Railroad.
Boston & Maine: —			
Western division, . . .	Lowell Junction, . .	79	24
Southern division, . . .	Bleachery, . . .	70	29
Fitchburg division, . . .	Concord Junction, . .	56	27
Boston & Albany, ...	South Framingham, .	42	28

In the matter of mileage East Boston possesses marked advantages over South Boston for Boston & Maine traffic, when routed via existing connections.

E. Suggested Future Connection for the Possible Diversion of Fitchburg Division and Boston & Albany Traffic to South Boston. — The distances to South Boston as presented in the above table can be reduced by approximately 17 miles by the construction of a new line about 11 miles long, from a point on the Fitchburg branch of the New Haven about 2 miles south of South Framingham, easterly across the Woonsocket branch about half a mile north of Dover station, thence easterly and southerly to a connection with the Midland division, main line, at the highway overcrossing about a quarter of a mile north of Islington station.

A tentative route is indicated on the railroad map, Plate I., appended.

In order to maintain maximum grades of .5 per cent., that section of the route between the Woonsocket branch and the Midland division will encounter considerable rock cutting, and will require consequent heavier construction than the first section, which passes through comparatively flat country.

There is no doubt that the best ultimate results in despatch and economy of operation will follow from the construction of a connection, substantially as shown, direct to the main line, whence, by four tracking the Midland division, practically an independent double-track freight line will be available to South Boston.

If the prospective freight traffic for a reasonable period in the future can be operated with safety and despatch over existing branches, then construction of the first section only, to a junction with the Woonsocket branch, would be warranted at the outset.

This first section should be designed, however, with a view to an ultimate extension over the Woonsocket branch to the main line, Midland division, near Islington, and the junction at grade with the Woonsocket branch considered merely incidental.

2. Atlantic Avenue.

The water front of Boston proper, along Atlantic Avenue and Causeway Street, was discussed above in connection with "Improvements to Union Freight Railroad."

There are at present served along this water front several important lines of coastwise vessels handling passengers, through freight and goods for local delivery. With the capacity of the Union Freight Railroad increased, tonnage for transshipment can be placed on the piers along Atlantic Avenue from any trunk line.

As the present piers become inadequate to meet the requirements of the larger vessels as they gradually replace those of the present smaller type, new and longer piers must be constructed, or the business must be transferred to East or South Boston. On account of the passenger business conducted by the various lines, together with tonnage handled for local delivery, it is considered most desirable to continue the service by these lines of coastwise vessels on the water-front of the city proper.

In connection with the proposed Atlantic Avenue local delivery yard, three new piers are proposed, having an effective length of 700 feet (no extension to the harbor line being practicable at this point) and a width of about 90 feet, with slips 150 feet wide.

The entire development proposed appropriates the present wharf areas and slips of T, Commercial and Lewis wharves, and, aside from providing an area necessary for the proposed Atlantic Avenue local delivery yard, provides an effective pier frontage for the accommodation of seven 700-foot vessels.

The present pier frontage within these limits is most ineffective and will accommodate but four vessels from 400 to 700 feet in length, besides several less than 300 feet long. Furthermore, this is possible only by utilizing the piers and slips now given over to the fishing interests.

Present property necessary for the construction of these three new piers with the slips should be acquired by the city, and the new facilities constructed with city funds. The piers can then be leased, the entire transaction being on a revenue paying basis.

3. Industrial Development.

Were it possible to interest private capital in a development of manufacturing interests on the water front, with possibilities of direct rail shipment via any entering trunk line, as well as direct shipment by water from docks immediately contiguous to and a part of the general properties, the realization of such a project would prove of great benefit to the port. Such a proposition, under one general management, with cheap and reliable power available from one or more central stations, with warehouses and factories isolated or in groups to suit tenants, with industrial tracks connecting all factories and warehouses with each other, with the piers and with a general storage and switching yard, and via the proposed clearing yard to the several trunk lines, would represent the greatest economy in production.

Such a manufacturing district cannot reach the best ultimate layout if developed jointly with terminal features for strictly transportation purposes. That is, the best ultimate results will follow the development of separate localities or parcels for these respective purposes.

The property now owned by the Commonwealth at South Boston is wide enough for the construction of piers 1,200 feet long, with ample space in the rear of the bulkhead line for the location of switching and storage tracks, as may be required. There is also room along the northerly side of Summer Street for the location of factory buildings for 150 or 200 feet from the street line. The property is not of sufficient dimensions, however, for the development of a self-contained industrial

center in addition to the future requirements for railroad terminal purposes.

We find on the flats between East Boston and Winthrop, north of Wood Island Park, an area that is susceptible of most satisfactory ultimate development as a manufacturing district. A tentative layout is indicated on the drawing, Plate III., appended, as well as a secondary development on the northerly half of the peninsula of new pier frontage, the southerly half of which becomes an extension of the present Boston & Albany terminal.

The ultimate development suggested provides for the maintenance of open water off Wood Island Park to the Winthrop shore, thus continuing a desirable feature of the park.

The initial development in the primary layout north of Wood Island Park might include but one or two piers with the corresponding warehouses and factories, lying next to the East Boston shore. From this initial installation, a duplicating system of extension would reach ultimate results substantially as shown. The primary installation outlined comprises an area 50 per cent. in excess of that now occupied by the entire Bush Terminal properties in Brooklyn.

This location possesses the advantages of being immediately adjacent to the northerly end of the proposed marginal railroad, where the construction of but 1 mile of railroad, wholly across flats and unimproved property, would provide direct rail connection via the Grand Junction Railroad and the proposed clearing yard with every trunk line entering Boston.

The site is also in close proximity to the East Boston labor market, and the housing of operatives in model tenement districts on the undeveloped uplands of East Boston, and within walking distance of the factory sites, would be possible. The southeasterly part of Chelsea would also be available for a like purpose.

With the development of the Boston, Revere Beach & Lynn Railroad into a standard-gauge electrified line, entrance into Boston proper via a tunnel under the harbor, and the introduction of this road into the proposed suburban passenger system of the Metropolitan District, the proposed site could be reached direct by rail from any suburb of Boston.

To the disadvantage of this suggested location for the initial industrial development must be mentioned the necessity of dredging a channel nearly 3 miles long to President Roads. This disadvantage, however, applies as well to any site that may be chosen on the East Boston flats, except that reserved for the extension of railway terminal purposes, which area it is deemed inadvisable to develop jointly for industrial purposes.

There should be mentioned here the advisability of utilizing every yard of dredged material for the purpose of making land. It is believed that practically all of the material can be economically handled by hydraulic methods and deposited where desired.

Although it is believed that such an enterprise must recommend itself to and depend upon private capital for execution, it is possible that the Commonwealth, in order to further a project which would manifestly make for a large increase in the commerce of the port, might with entire propriety for the general benefit of the community offer to dredge a channel to the initial development, if private funds were forthcoming to prosecute the development itself.

4. Free Port.

If in the course of future events it becomes advisable to establish a free port at the port of Boston, an adequate portion of the northerly front of the suggested peninsular development can be dedicated to this purpose.

5. Commonwealth Property.

On drawing, Plate III., appended, the property now owned by the Commonwealth is denoted by crosshatching. The question of ownership of Noddle Island flats, lying easterly of the existing exterior harbor line, is now before the courts. Should the decision be favorable to the Commonwealth the present holdings of the State will be very greatly increased.

The parcel in East Boston lying just inside of the present exterior line, and south of Wood Island Park flats, was acquired pursuant to recommendations embodied in the "Report of the State Board on Docks and Terminal Facilities" (see chapter 291, Acts of 1895), submitted in 1897.

The Commonwealth Pier at South Boston was also constructed as an initial step in the ultimate development of the South Boston water-front property of the Commonwealth, as recommended by this Board.

Several obvious courses are open to the Commonwealth in the matter of the development or disposition of the flats now owned at East and South Boston.

At South Boston, the water front, including the Commonwealth Pier, must be utilized for railroad terminal purposes, as increased traffic may warrant an extension to present facilities, and the dedication of this property to any use that would prevent such a development would be most ill advised.

Furthermore, any development along independent lines at variance with the needs of the transportation companies would be entirely unwarranted. The best interest of the community absolutely demands a joint consideration and development of the parcel in question. In the event of the formation of a Metropolitan Terminal Transportation Company, in which the Commonwealth had due representation, the parcel would become one of the assets of the company. On the other hand, should the inland transportation companies maintain their identity, the Commonwealth might sell or lease its water-front holdings to the railroad company, or construct new piers as necessary and lease these facilities.

At East Boston the disposition of the parcel recently acquired is obviously somewhat dependent upon the ownership of Noddle Island flats. Should the courts decide adversely to the Commonwealth, this parcel might be exchanged for one of a similar shape and like area contiguous to the northerly exterior pierhead line of the suggested peninsular development. On the other hand, should the decision be favorable to the Commonwealth, practically all of Noddle Island flats will be at the disposal of the State. As in the case of South Boston property, independent action will prove ill advised.

Marginal Railroads.

It is obvious that any water-front development to be most effective must have rail service at the piers. The following marginal railroads and connections are suggested: —

1. Proposed East Boston Railroad.

On drawing, Plate III., appended, is indicated the East Boston railroad, proposed to give direct rail service to the present piers along the northerly and westerly fronts of East Boston. From a connection with the Grand Junction Railroad just south of the Chelsea Creek bridge the proposed road enters Condor Street, follows this thoroughfare to Border Street and in the latter to Sumner Street.

2. Proposed Marginal Railroad to serve the Easterly Water Front of East Boston.

In order to develop the flats lying southeasterly of East Boston, rail service is of course essential, and for this purpose a marginal railroad is proposed, lying easterly of and immediately adjacent to the Revere Beach road, from Trumbull Street south to a point north of Maverick Street, thence swinging easterly to a connection with the tracks proposed to serve the Railroad Terminal Docks. The proposed road is indicated on the drawing, Plate III., appended.

3. Proposed Connecting Railroad from Grand Junction Railroad in Chelsea to Proposed Marginal Railroad.

There are several possible connections from the Grand Junction Railroad to the proposed marginal railroad. It is desirable, however, to connect at the northerly end of the proposed marginal railroad, near Trumbull Street, where the Revere Beach road would be elevated and carried over the proposed connecting railroad. The suggested route, about 1¼ miles long, would leave the Grand Junction Railroad about opposite Highland Street in Chelsea, and continue easterly across the flats and Chelsea Creek to a crossing at the grade of, and a connection with, the old Boston & Maine right of way from Revere to East Boston. The line would then continue easterly across the flats and southerly, east of Trumbull Street, under the Revere Beach line (to be elevated) near Trumbull and Bennington streets, to a connection with the proposed marginal railroad.

This suggested connection involves an additional railroad bridge with draw across Chelsea Creek. It is obvious, however,

that with a connection from the proposed line to the old Boston & Maine right of way, that portion of the Grand Junction Railroad as it exists between Highland Street (Chelsea) and Curtis Street (East Boston), a distance of about three quarters of a mile, including the present Chelsea Creek bridge, can be abandoned and released for other uses.

Grand Junction Railroad traffic would reach the East Boston terminal via the proposed connecting railroad to the old Boston & Maine right of way, thence by the latter to a point on the present Grand Junction road just north of Curtis Street. No revision in the recently completed improvements would be necessary, and the additional distance would be slight, only about one quarter of a mile.

The proposed line would connect, near Trumbull Street, with the Revere Beach road, so that after the establishment of this line on a standard-gauge basis, it would have freight service direct from the proposed clearing yard. Revere and Winthrop would thus enjoy the benefits of the proposed local freight delivery system.

Throughout practically its entire length of 1¼ miles, the proposed connection would traverse marsh land, or land under water only, and would involve street crossings with only six public thoroughfares, as the maps of Chelsea and East Boston are now projected. On the other hand, any connection from the existing location of the Grand Junction Railroad through East Boston would cross some ten streets on the projected map of East Boston, and necessarily intersect the proposed marginal railroad at some intermediate point, rather than at the northerly end, making necessary reverse movements for traffic.

The several connections are indicated on drawing, Plate III., appended.

4. Ultimate Circuit Marginal Road around East Boston Water Front.

With the extension of Boston & Albany dock frontage to the east, the connecting tracks should ultimately reach and connect with the proposed marginal railroad, thus resulting in a belt line or circuit.

The proposed East Boston railroad, for serving the dock

frontage on the west and north fronts of East Boston, is subject to a possible ultimate extension to a connection with the tracks of the Boston & Albany terminal.

The realization of these projects would result in a circuit road around the entire water front.

V. CONCLUSIONS.

It is to be regretted that the foregoing report is lacking in that important detail, an estimate of cost for prosecuting the work. As time has been limited, it has been impossible to carry the studies to that point which would warrant the presentation of an estimate which would be of any real value. A figure based on data at hand would be merely a guess and might prove entirely misleading.

One fact stands out paramount to all, — the necessity of concerted action to the subjugation of selfish motives. In no other way can an enduring system be planned and much less executed. The unity of the entire problem must be accepted as the foundation whereon the superstructure is to be erected and knit together into a homogeneous system.

It is obvious from the scope of the development suggested that, as regards freight tonnage, actual competition among the present steam lines is practically eliminated within the terminal district and relegated to trunk line haul. The proposed district system of local freight delivery to a great extent retires the various points of strategic advantage in the matter of terminal deliveries at present respectively characteristic of the several railroad systems in favor of the broader policy of extending every advantage to all terminal patrons, irrespective of location. This step is believed to be eminently in line with ultimate economy of production as well as the highest type of public service.

The general development proposed, based on the joint operation of all terminal properties within practicable limits, provides a degree of operating flexibility as regards both the freight and passenger distributing systems which leaves little to be desired in a development designed to meet future requirements which at present may be indeterminate. The ultimate

capacity outlined for the distributing systems, as well as for the water front, provides for a large increase in the general commerce of the port, which will require for its fulfillment a continued growth of many years at the present or a greater rate.

TABLE NO. I. — *Total Gross Tonnage handled in Boston for the Year 1907.*

	INWARD.		OUTWARD.		GRAND TOTALS.	
	Export.	Total Gross Tons.	Import.	Total Gross Tons.	Gross Tons.	Per Cent.
New York, New Haven & Hartford.	6,000	1,553,870	52,688 [1]	1,213,600	2,767,470	17
Boston & Albany, . .	473,416	2,486,104	153,505	1,562,607	4,048,711	25
Boston & Maine, . .	790,984	4,630,926	519,239	4,662,191	9,293,117	58
Totals, . . .	1,270,400	8,670,900	725,432	7,438,398	16,109,298	100
Per cent. of grand total, .	7.9	53.8	4.5	46.2	100	-

[1] Almost exclusively manila hemp and Mexican sisal consigned to the North Plymouth Cordage Works.

TABLE NO. II. — *Percentages of Total Gross Tonnage handled by Each Trunk Line, and at Each Local Delivery Station, in Boston, for the Year 1907.*

	At Local Delivery Station.	By Trunk Line.	Totals.
Boston & Maine.			
Southern division: —			
Mystic Wharf, ...	6.4		
Rutherford Avenue, ...	3.2		
Warren Bridge, ...	1.2		
Minot Street and East Cambridge, ...	9.0		
		19.8	
Eastern and Western divisions: —			
Mystic Wharf, ...	6.4		
Rutherford Avenue, ...	12.8		
Warren Bridge, ...	.4		
		19.6	
Fitchburg division: —			
Mystic Wharf, ...	4.2		
Warren Bridge, ...	14.4		
		18.6	
			58
Boston & Albany.			
Main line: —			
Kneeland Street and Huntington Avenue, . .	6.8		
East Boston, ...	11.4		
East Cambridge, ...	4.2		
Brighton, ...	2.6		
		25.0	
			25
New York, New Haven & Hartford.			
South Boston and Massachusetts Avenue, via Providence division.	. . .	8.8	
Midland division, ...	. . .	2.6	
Plymouth division, ...	. . .	5.6	
			17
Totals, ...	. . .	. . .	100

TABLE NO. III.—*Westbound Import Freight, showing Total Tonnage destined to and beyond the Trunk Lines' Western Terminal (Buffalo), forwarded by Each Railroad from Boston for the Fiscal Year ending June 30, 1907.*

[Compiled by the Trunk Lines Association of New York City.]

	Boston & Albany.		Boston & Maine.		New York, New Haven & Hartford.	
	Tons.	Per Cent.	Tons.	Per Cent.	Tons.	Per Cent.
1906.						
July,	240	1.9	10,756	86.1	1,491	12.0
August,	177	1.7	9,823	94.4	411	3.9
September,	231	3.2	5,820	82.1	1,036	14.6
October,	186	1.9	9,336	92.9	827	5.2
November,	328	3.2	9,788	94.2	271	2.6
December,	204	2.2	8,233	90.6	653	7.2
1907.						
January,	322	3.0	10,403	94.6	268	2.4
February,	398	5.4	6,990	94.4	14	.2
March,	1,247	14.5	7,347	85.5	-	-
April,	816	6.7	11,387	93.3	-	-
May,	942	11.0	7,603	89.0	-	-
June,	906	8.8	9,378	91.2	-	-
Totals,	5,997	5.1	106,864	90.7	4,971	4.2

TABLE NO. IV.—*Statement of Freight exported via Port of Boston, showing the Per Cent. handled by the Several Railroads for the Fiscal Year ending June 30, 1907.*

[Compiled from steamer manifests.]

	Total Tons.	Via Boston & Maine.		Via Other Lines.[1]	
		Tons.	Per Cent.	Tons.	Per Cent.
1906.					
July,	73,044	37,282	51	35,762	49
August,	83,823	47,838	57	35,985	43
September,	88,924	50,068	56	38,856	44
October,	87,221	49,881	57	37,340	43
November,	85,441	53,387	60	32,054	40
December,	106,279	69,207	65	37,072	35
1907.					
January,	101,933	72,714	71	29,219	29
February,	81,621	52,663	64	28,958	36
March,	98,121	68,401	70	29,720	30
April,	94,393	55,753	59	38,640	41
May,	109,567	62,375	56	47,192	44
June,	89,925	50,618	56	39,307	44
Totals,	1,100,292	670,187	61	430,105	39

[1] Practically all Boston & Albany tonnage, only ½ of 1 per cent. being received via the New Haven road.

TABLE NO. V. — *Export and Import Tonnage in Boston for the Year 1907.*

	Boston & Albany.	Boston & Maine.	New York, New Haven & Hartford.	Totals.
Export (tons),	473,416	790,884	6,000	1,270,400
Per cent. of total tonnage,	2.9	4.9	.04	7.84
Per cent. of total export and import tonnage.	23.7	39.6	.30	63.60
Per cent. of total export tonnage,	37.2	62.3	.50	100.00
Per cent. of line export and import tonnage.	75.5	60.4	10.20	-
Import (tons),	153,505	519,239	52,688	725,432
Per cent. of total tonnage,	1.0	3.2	.36	4.56
Per cent. of total export and import tonnage.	7.7	26.0	2.70	36.40
Per cent. of total import tonnage,	21.1	71.6	7.30	100.00
Per cent. of line export and import tonnage.	24.5	39.6	89.80	-
Totals (tons),	626,921	1,310,223	58,688	1,995,832
Per cent. of total tonnage,	3.9	8.1	.40	12.40
Per cent. of total export and import tonnage.	31.4	65.6	3.00	100.00

TABLE NO. VI. — *Comparative Statement of Teamed Tonnage in Boston for the Year 1907.*

FREIGHT STATIONS.	TONS.			TON MILEAGE.[1]					NUMBER OF PATRONS.		
	Total.	Hauled beyond District Limits.	Per Cent. hauled beyond District Limits.	Total.	Average Total Haul in Miles.	Hauled beyond District Limits.	Average Haul in Miles beyond District Limits.	Per Cent. hauled beyond District Limits.	Total (except "Casual" Patrons).	Within District Limits.	Beyond District Limits.
Boston & Maine.											
Minot Street,	784,800	613,200	78	566,300	.72	254,800	.41	45	443	65	378
Mystic Wharf,	62,000	45,600	75	93,500	1.50	52,800	1.15	56	16	6	10
Warren bridge,	1,428,700	856,400	60	1,303,900	.91	482,100	.56	37	1,456	761	695
Rutherford Avenue,	744,900	611,200	82	1,900,000	2.55	1,326,600	2.17	70	1,010	26	984
Boston & Albany.											
Kneeland Street,	875,200	446,350	51	396,700	.45	214,200	.48	54	1,073	193	880
Huntington Avenue,	80,550	65,250	81	138,900	1.72	88,900	1.36	64	48	–	48
East Cambridge,	35,400	–	–	15,600	.44	–	–	–	30	30	–
New York, New Haven & Hartford.											
Congress Street,	1,875,400	712,200	40	1,795,400	.96	853,500	1.20	47	2,591	1,125	1,466
Totals,	5,886,950	3,350,200	57	6,210,300	1.05	3,272,900	.97	53	6,667	2,206	4,461

[1] Including only tonnage of patrons handling 500 tons per annum or over.

TABLE NO. VI. — *Comparative Statement of Teamed Tonnage in Boston for the Year 1907* — Concluded.

FREIGHT STATIONS.	OUTWARD.					INWARD.				
	Shippers.	Tons.	HANDLING OVER 500 TONS PER ANNUM.			Receivers.	Tons.	HANDLING OVER 500 TONS PER ANNUM.		
			Number.	Tons.	Per Cent. of Total Tons.			Number.	Tons.	Per Cent. of Total Tons.
Boston & Maine.										
Minot Street,	373	208,000	40	58,400	28	104	576,800	71	301,700	52
Mystic Wharf,	14	39,000	12	38,200	98	11	22,900	10	22,500	98
Warren bridge,	958	448,200	157	318,900	71	1,089	980,400	240	691,900	71
Rutherford Avenue,	839	630,800	156	483,400	77	332	114,000	35	63,900	56
Boston & Albany.										
Kneeland Street,	225	273,500	73	38,000	14	1,050	601,700	93	107,300	18
Huntington Avenue,	2	250	2	250	100	48	80,300	18	45,500	57
East Cambridge,	10	13,600	1	600	4	24	21,800	–	–	–
New York, New Haven & Hartford.										
Congress Street,	2,546	663,900	215	333,700	50	2,293	1,211,500	262	933,000	77
Totals,	4,967	2,277,250	656	1,272,250	56	4,951	3,609,400	729	2,165,800	60

TABLE No. VII. — *Comparative Statement of Teamed Tonnage in Boston for the Year 1907.*

[Comprising data covering only the four freight stations of Boston proper.]

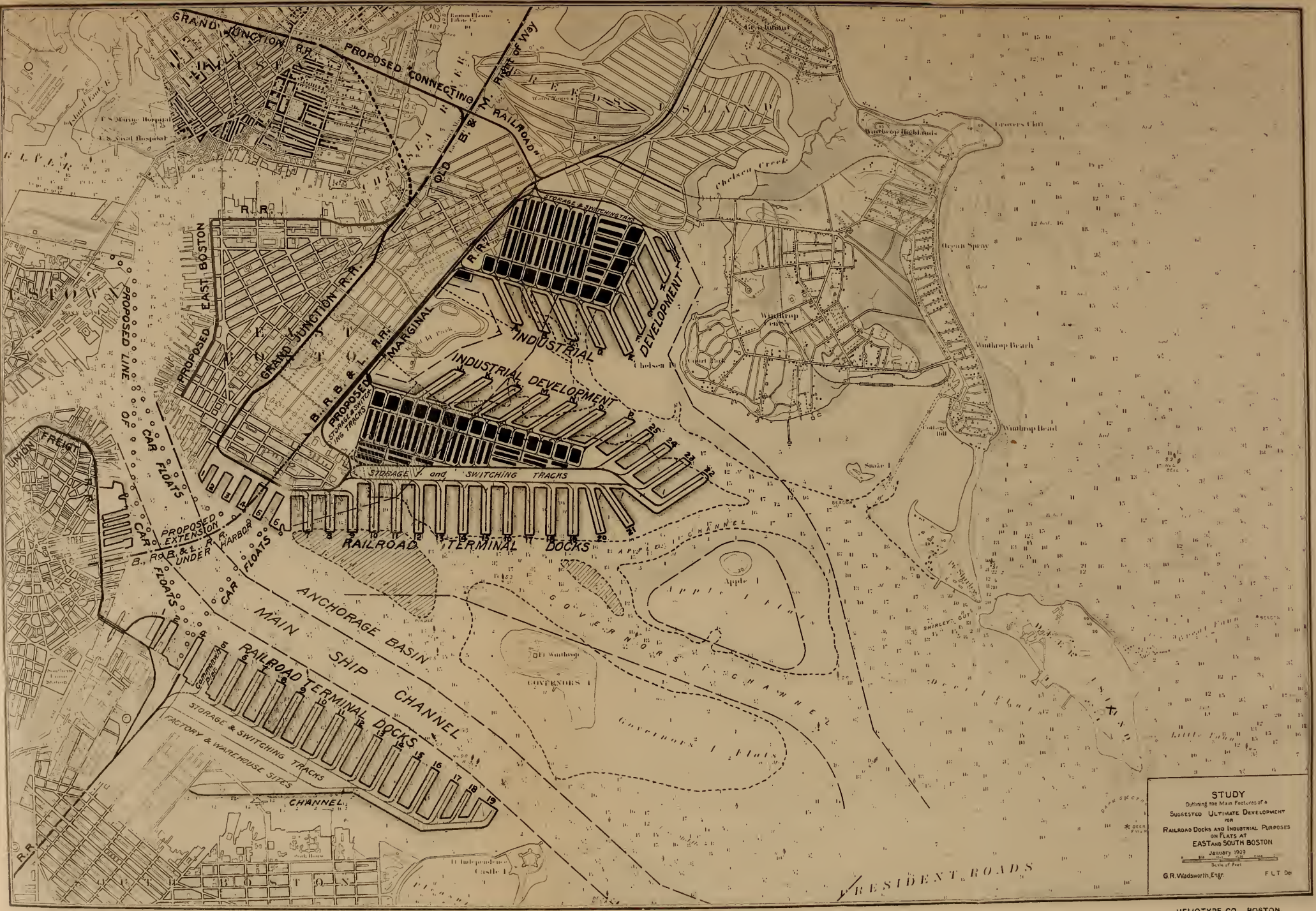
FREIGHT STATIONS.	TONS.			TON MILEAGE.[1]				
	Total.	Hauled to or from Points within District Limits of Three Other City Stations.	Per Cent. hauled to Points within District Limits of Three Other City Stations.	Total.	Average Haul in Miles.	Hauled to or from Points within District Limits of Three Other City Stations.	Average Haul, in Miles, to or from Points within District Limits of Three Other City Stations.	Per Cent. hauled to points within District Limits of Three Other City Stations.
Boston & Maine.								
Minot Street,	784,800	608,900	78	566,300	.72	247,500	.41	44
Warren Bridge,	1,428,700	490,700	34	1,303,900	.91	225,700	.46	17
Boston & Albany.								
Kneeland Street,	875,200	428,500	42	396,700	.45	167,100	.39	42
New York, New Haven & Hartford.								
Congress Street,	1,875,400	627,900	33	1,795,400	.96	600,300	1.05	37
Totals,	4,964,100	2,156,000	43	3,810,600	.79	1,300,600	.60	33

[1] Including tonnage of patrons handling 500 tons per annum or over.

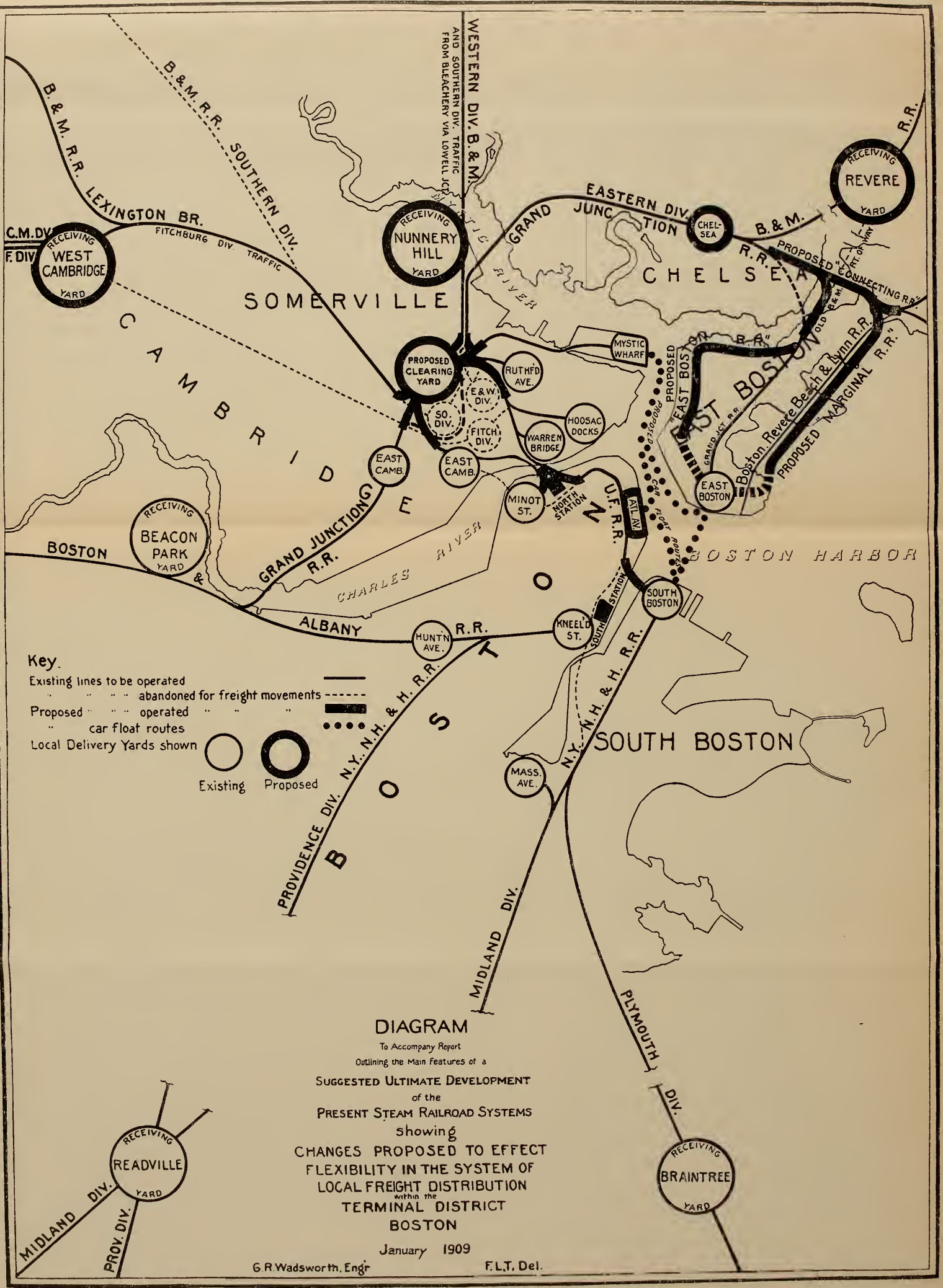
PLATE I.

RAILROAD MAP
To accompany Report
Outlining the Main Features of a
SUGGESTED ULTIMATE DEVELOPMENT
of the
PRESENT STEAM RAILROAD SYSTEMS
BOSTON
January 1909
BOSTON
CHARLESTOWN
CHELSEA
EAST BOSTON
SOUTH BOSTON
DORCHESTER
ROXBURY
BRIGHTON
WEST ROXBURY
HYDE PARK
MILTON
QUINCY
BRAINTREE
WEYMOUTH
HOLBROOK
RANDOLPH
CANTON
STOUGHTON
AVON
NORWOOD
WESTWOOD
DEDHAM
NEEDHAM
WELLESLEY
NEWTON
WALTHAM
WATERTOWN
BELMONT
ARLINGTON
CAMBRIDGE
SOMERVILLE
MEDFORD
EVERETT
MALDEN
REVERE
WINTHROP
SAUGUS
LYNN
LYNNFIELD
PEABODY
DANVERS
MIDDLETON
NORTH READING
READING
WAKEFIELD
WOBURN
STONEHAM
MELROSE
WINCHESTER
LEXINGTON
BURLINGTON
BEDFORD
LINCOLN
CONCORD
CARLISLE
BILLERICA
TEWKSBURY
ANDOVER
NORTH ANDOVER
BOXFORD
TOPSFIELD
METHUEN
LAWRENCE
SALEM
LOWELL
WESTFORD
CHELMSFORD
TYNGSBOROUGH
ACTON
SUDBURY
WAYLAND
FRAMINGHAM
NATICK
ASHLAND
HOPKINTON
HOLLISTON
MEDWAY
FRANKLIN
NORFOLK
WRENTHAM
MILFORD
BOSTON & MAINE R.R.
N.Y.N.H. & H. R.R.
MAIN LINE
WESTERN DIV.
SOUTHERN DIV.
NEWBURYPORT BR.
SO. READING BRANCH
LAWRENCE BR.
SALEM BR.
LOWELL BR.
WOBURN LOOP
DISTRICT
PARKS
LEXINGTON BR.
METROPOLITAN
REFORMATORY BR.
FITCHBURG
CENTRAL MASS. DIV.
LOWELL BR.
ACTON BR.
MARLBORO BR.
SOUTHBORO BR.
EASTERN R.R.
SAUGUS BR.
B.&A. R.R.
B.&M. R.R.
MAIN LINE
WESTERN DIV.
SOUTHERN DIV.
WOBURN JUNCTION
MEDFORD BR.
BELMONT BR.
WATERTOWN BR.
NEWTON BR.
NEWTON W.W. RES.
HIGHLAND BR.
BROOKLINE
BOSTON & ALBANY R.R.
MAIN LINE
WESTERN DIV.
NEWTON BR.
NEWTON W.W. RES.
HIGHLAND BR.
BROOKLINE
PROVIDENCE
PLYMOUTH
W. QUINCY
MIDLAND DIV.
PROVIDENCE DIV.
PLYMOUTH DIV.
BLUE HILL RESERVATION
BOUNDARY
DISTRICT
STOUGHTON BR.
STORY BROOK RES.
W. ROXBURY
ARNOLD ARBORETUM
BROOKLINE RES.
NEWTON W.W. RES.
NEWTON BR.
WATERTOWN BR.
BELMONT BR.
MEDFORD BR.
WOBURN JUNCTION
SOUTHERN DIV.
WESTERN DIV.
MAIN LINE
WOBURN LOOP
DISTRICT
PARKS
LEXINGTON BR.
METROPOLITAN
REFORMATORY BR.
FITCHBURG
CENTRAL MASS. DIV.
LOWELL BR.
ACTON BR.
MARLBORO BR.
SOUTHBORO BR.
B.&M. R.R.
N.Y.N.H. & H. R.R.
B.&A. R.R.
B.&M

HELIOTYPE CO., BOSTON.



HELIOTYPE CO., BOSTON.



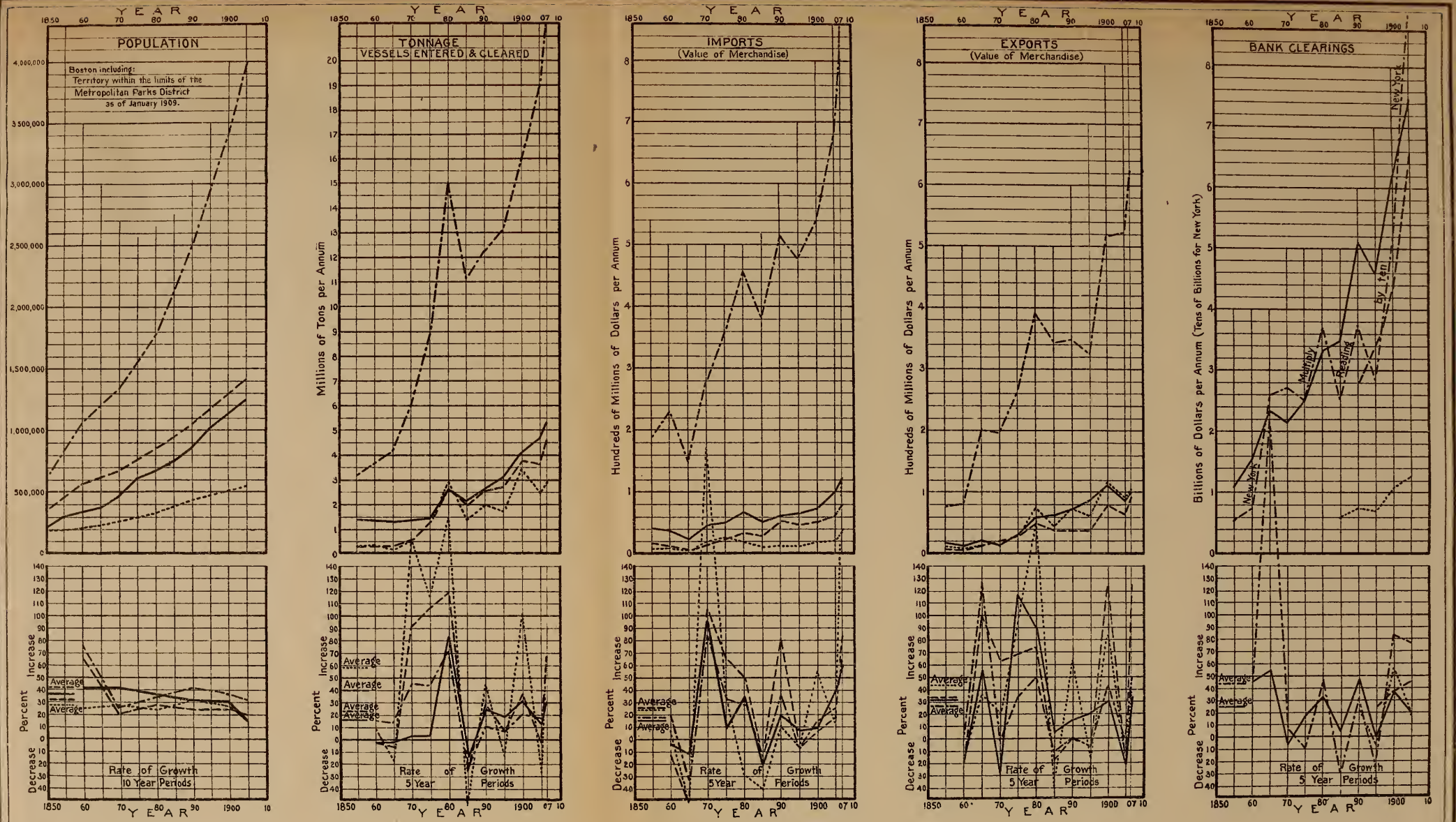
DIAGRAM

To Accompany Report
Outlining the Main Features of a
SUGGESTED ULTIMATE DEVELOPMENT
of the
PRESENT STEAM RAILROAD SYSTEMS
showing
CHANGES PROPOSED TO EFFECT
FLEXIBILITY IN THE SYSTEM OF
LOCAL FREIGHT DISTRIBUTION
within the
TERMINAL DISTRICT
BOSTON

January 1909

G.R. Wadsworth, Engr F.L.T. Del.

PLATE - IV



DIAGRAMS

to accompany report
Outlining the Main Features of a
SUGGESTED ULTIMATE DEVELOPMENT
of the
PRESENT STEAM RAILROAD SYSTEMS
Showing Growth in
Population, Tonnage, Imports, Exports & Bank Clearings
for
Boston · New York · Philadelphia and Baltimore
from
1850 to 1907

G. R. Wadsworth, Engr. Jan. 1909. F. L. Tibbetts, Del.

Key { Boston ——— New York ·—·— Philadelphia — — — Baltimore ------

HELIOTYPE CO., BOSTON.

PROPOSED SUB-SURFACE CONNECTION BETWEEN NORTH AND SOUTH STATIONS

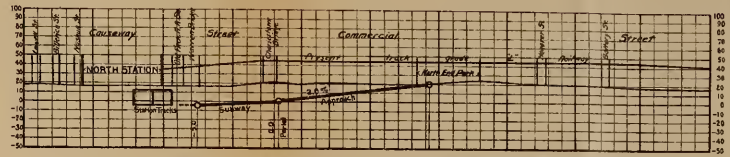
Alternate Approach Grades - Extreme Conditions.

A-A & B-B. Drawbridge, raised to provide 23 feet clearance above mean high water (elevation +10.0) as recommended by the War Department.

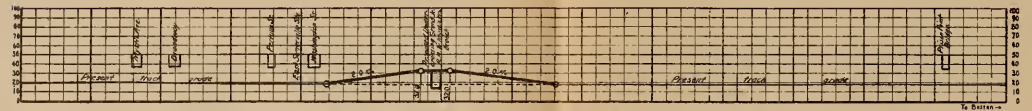
C-C. Elevation and location of Draw Bridge maintained as at present.

D-D & E-E. Tunnel approach - providing 20 feet over roof of tunnel to mean low water (elev. 0.0)

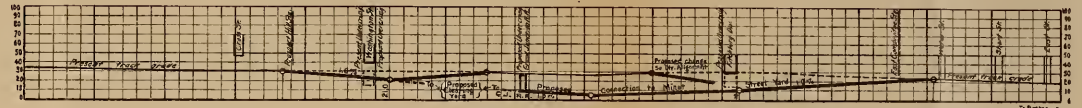
Note:— It is considered impracticable to adopt any of the above alternate grades, construct a sub-surface connection between the North & South Stations, and maintain a "North Station" on the South side of the Charles River.



PROPOSED SUBWAY — UNION FREIGHT RAILROAD



EASTERN AND WESTERN DIVISIONS B. & M. R.R.



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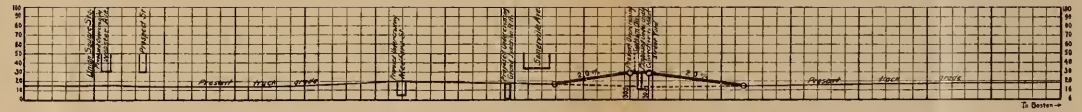
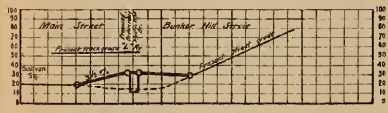
GRAND JUNCTION RAILROAD (B. & A. R.R.)

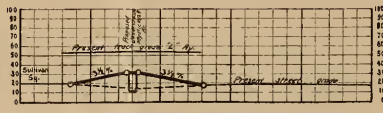


FITCHBURG DIVISION B. & M. R.R.

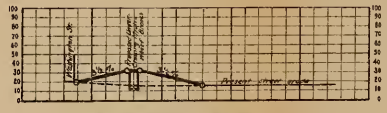
MYSTIC WHARF BRANCH B. & M. R.R.



BUNKER HILL STREET



MAIN STREET



RUTHERFORD AVENUE

PROFILES

To Accompany Study Outlining

MAIN FEATURES OF A SUGGESTED ULTIMATE DEVELOPMENT

of the

PRESENT STEAM RAILROAD SYSTEMS

BOSTON

January, 1909

SCALES INDICATED

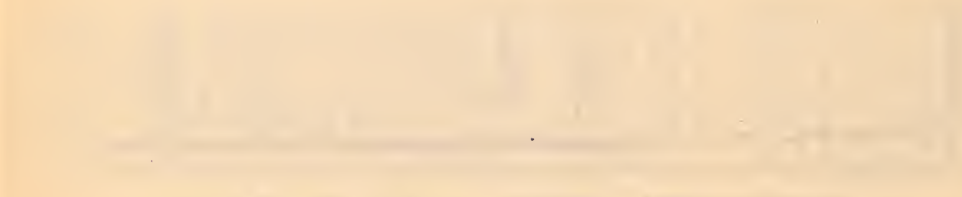
G.R. Wadsworth Engr

F.L. Tibbetts, Del.

NOTE: ELEVATIONS AND STATIONING ARE APPROXIMATE ONLY.

Datum: Mean Low Water Boston Harbor.

HELIOTYPE CO., BOSTON.



Docks.

BY DESMOND FITZGERALD, CONSULTING CIVIL ENGINEER.

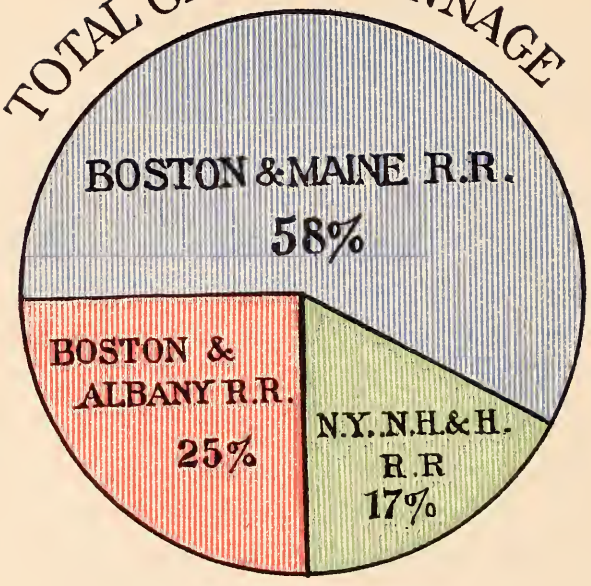
Soon after the organization of the Metropolitan Improvements Commission an effort was made to secure the services of some dock expert who could give his personal attention to the problem of docks for Boston, but without success. It devolved upon the writer, as the engineer member of the commission, to give such time to the question as he could command, and this has resulted in the following report.

A careful examination of the inner and outer harbors connected with the port of Boston will inevitably lead to the conclusion that they offer extraordinary natural advantages for commercial traffic. The approaches from the ocean are wide and safe, and the roadsteads such as to provide ample space for a large number of ships. Three broad and deep channels, dredged by the government, give access from several directions. Many of the great harbors of the world are entered only by following long and dangerous river channels which are obstructed by shifting sand-bars, and others have required expensive breakwaters and jetties to guard the entrances from the force of the waves. In Boston harbor the islands afford a natural protection to broad expanses of water, where excellent anchorage ground may be found. Boston, in common with American ports, has an advantage over those on the other side of the water, in that the rise and fall of the tide is so moderate — 9.8 feet on the average at Boston — that it is not necessary to go to the great expense of constructing a wet-dock system by enclosing large areas with walls, locks and gates, which are obstructions to all movements of boats. Owing to the wonderful diversity of the harbor lines, and the enormous extent of water front in and

1907

16,109,298 tons.

TOTAL GROSS TONNAGE

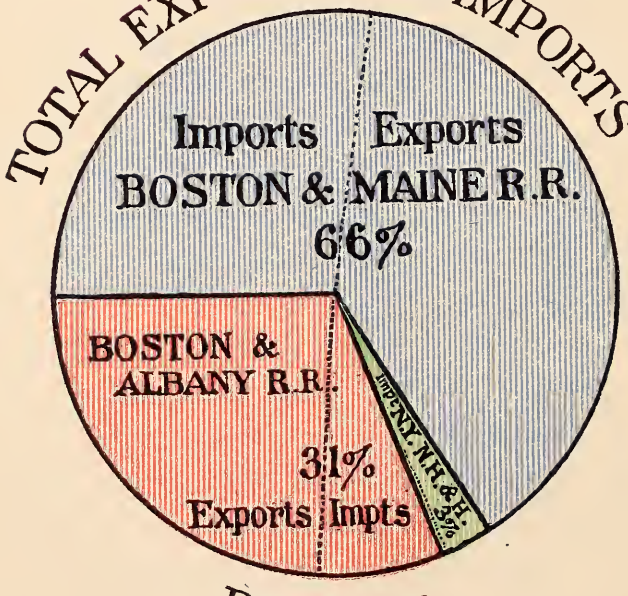


BOSTON

1907

1,995,832 tons.

TOTAL EXPORTS and IMPORTS



BOSTON

Freights.

While volumes might be written on this subject alone, the whole matter, so far as it applies to the solution of the problem before us, can be simplified and reduced to a brief statement, easily understood.

Unlike most foreign ports, those of America, so far as the distribution of imports and exports are concerned, owe their existence to the railways instead of to rivers and canals. The railway terminals are the foci of foreign shipping. Boston is no exception to the rule. We have three great railways — the Boston & Maine, the Boston & Albany and the New York, New Haven & Hartford — directly concerned in these matters, and each has its terminal for the exchange of commodities on the water front. Of the total 16,109,298 tons of railroad freight handled in Boston and its suburbs during the year 1907, only 1,970,000 tons were imports and exports.

The following brief table shows the distribution of this traffic among the roads above named: —

RAILROADS.	Freights — 1907.	
	Gross at Boston (Tons).	Imports and Exports, Boston (Tons).
Boston & Maine Railroad, ...	9,293,117	1,310,223
Boston & Albany Railroad, ...	4,048,711	626,921
New York, New Haven & Hartford Railroad, . .	2,767,470	58,688
Totals, ...	16,109,298	1,995,832

The first column shows at a glance the distribution of the gross freight traffic, and the second, that of imports and exports. The above statistics have been plotted on the accompanying plates in diagrammatic form as percentages.

It will be seen from the above that so far as imports and exports are concerned the business of the New York, New Haven & Hartford Railroad may for the moment be neglected, as it amounts to but 3 per cent. of the whole, and also that out of the total imports and exports of the port the Boston & Maine

Railroad handles 66 per cent. and the Boston & Albany 31 per cent., — in other words, the Boston & Maine Railroad does the giant's share of the business. A due consideration of this important fact will throw a flood of light upon the proper solution of the problem of docks.

Terminals.

The history of the formation of the terminals on the water front is a long and complicated one, and will be touched upon here only where necessary to enforce a lesson. A glance at the map will show a peculiar situation in connection with the terminals: that of the New York, New Haven & Hartford Railroad is at South Boston, where an extensive system of docks has been planned and partly carried out at great expense to the State and the railroad; that of the Boston & Albany Railroad is at East Boston, facing the city proper; and that of the Boston & Maine Railroad is at Hoosac Docks in Charlestown, across the Charles, and at Mystic Wharf, somewhat further up the inner harbor.

So far as the New York, New Haven & Hartford Railroad is concerned it has ample dock facilities, but as its foreign freight business is so small its position acts as a practical cut-off to the enjoyment of these facilities by the other roads. At one time the other roads might have been brought at comparatively moderate expense to this terminal, but there is no attractive plan by which this result can now be accomplished.

The Boston & Albany reaches its terminal in deep water by a long detour through its Grand Junction branch by way of Cambridge, Chelsea and East Boston. The improper location of the Grand Junction belt line across Cambridge streets and various branches of the Boston & Maine Railroad is well understood by students of transportation, but the day has long since gone by when this road can be materially changed or eliminated. To give a little idea of the firmly entrenched position of the Grand Junction branch, a table has been prepared showing the enormous industrial growth which has in recent years developed upon this ten miles of railroad. The table is too long for insertion here, but it contains a list of

62 separate industries. It is evident that these industries cannot be disturbed without striking an unwarranted blow at the business of the Metropolitan District. In addition to this development, the Boston & Albany Railroad recently spent something over $1,000,000 in abolishing grade crossings in East Boston in connection with the lease of the road to the New York Central Railroad. A great deal of minute investigation and time has been given by the writer to this phase of the situation, as an important element in the study for a future site for docks, and he has reached the conclusion, somewhat reluctantly it must be confessed, that the East Boston terminal of the Boston & Albany Railroad cannot be disturbed; that it will be modified and extended is more than probable.

We come now to the terminals of the Boston & Maine Railroad, with its large and rapidly growing business in imports and exports. This business must continue to develop, for the reason that the important portion of New England's business which remains to the port of Boston — and neglecting for the moment all considerations of the grain from the west, or imports sent to that section of the country — must continue to be distributed in larger and larger amounts by this railroad. The facilities controlled by the Boston & Maine Railroad for transacting this business are confined, as already stated, to the Hoosac Docks and Mystic Wharf. The former of these was originally the property of the Fitchburg Railroad, and is practically to-day the main dock terminal for the Boston & Maine system. Even a cursory examination shows that these docks are very limited, both in dimensions and in number, and incapable of enlargement, being squeezed in between the Navy Yard on the east, Charles River bridge on the west, a narrow entrance channel on the south, only about 625 feet wide, and Water Street on the north. The piers are of wood and the sheds also are of wood covered with tinned iron. The Hoosac Docks may be useful for coastwise traffic, but they can never be considered as part of a comprehensive system of docks for the future.[1]

[1] See twenty-ninth annual report of the Board of Harbor and Land Commissioners, for the year 1907, page 57, for evidence and conclusions on this same point.

Mystic Wharf is a valuable piece of property for the Boston & Maine Railroad, but the portion lying outside of the draw-bridges comprises but a small part of the wharf. The sheds are of wood, and in common with those at the Hoosac Docks have been swept by fire.

It is almost needless to say that the nucleus of an adequate dock system for the important business already secured by the railroad, with its rich promises for the future, cannot be found in such positions as have been here outlined. An ample dock system should at least be supplied with piers of sufficient length to accommodate the longest boats now sailing on the ocean, and with room to spare. They should be of ample width to provide highways, sheds and railroad tracks, should be of slow-burning construction, abutting on docks of liberal width, not less than 400 feet, and should be accessible by means of wide, straight channels which offer no obstructions to approaching ships. Measured by such standards, the Boston & Maine Railroad will soon require an entire change in its terminal facilities.

The Boston & Albany Railroad docks at East Boston have recently been seriously damaged by an extensive conflagration, which has obliged the railroad to undertake the important and very expensive work of reconstruction now under way. The new plan is on a much more comprehensive scale than that of the old wharves. The length of the piers and the width of the docks is somewhat increased. The new Cunard Pier No. 3 will be 772 feet in length and 240 feet wide. The dock on the easterly side is to be 250 feet wide, extending the entire length; on the westerly side the dock will be reduced to 200 feet, but its length will be 589.3 feet. The new Leyland Pier No. 4 will be of the same dimensions as the Cunard.

The railroad is also building a new grain elevator, with a capacity of 1,000,000 bushels. The pier deck outside of the sheds is to be covered with concrete, and the pier between high water and the deck is to be faced with reinforced concrete slabs 6 inches thick. The exterior walls of the sheds are to be covered with corrugated asbestos sheathing fastened to a steel framework, and the sheds are to be divided into compartments by fire walls. It is evidently the intention of the railroad to

make this new construction slow burning, — a step of some novelty and marking an advance in dock building in Boston.

No one versed in sound construction can visit the dock terminals of Boston without realizing that they are in the main the product of haphazard and patchwork policy, — largely unworthy of the port, and unsafe for present and prospective passenger and freight business. If the Boston & Maine Railroad could change places with the New York, New Haven & Hartford Railroad, it would have space for an unlimited traffic, — but this cannot be simply and economically accomplished.

Conclusions.

We are now brought to a logical result. A convenient and ample area must be sought, where commodious railroad yards may be established and where the ocean business of the Boston & Maine Railroad and the Boston & Albany Railroad may expand indefinitely, and where, at the same time, any other dock requirements of the port may be met.

There is in the opinion of the writer one large area which stands out conspicuously beyond the others in adaptability to the formation of a large port. The idea of a large port may seem to many somewhat visionary in connection with Boston. After a visit during the past summer to the principal ports of Europe, the writer has changed his whole point of view in connection with the question of docks for Boston.

It does not follow because a plan is made looking a long way into the future that it means an immediate carrying out of the whole plan. It simply means that each link in advance as it is built falls naturally into line with one comprehensive plan of development, varied according to the changes of the times, but always with ample room for growth, without waste of expenditures already made or the destruction of valuable property for additions. This is the course now pursued by every port in Europe. They all have comprehensive plans. Antwerp and Rotterdam are conspicuous examples. The result of past experience has taught these cities that a plan for dock development which provides only for the present wants is always a short-sighted policy, and every succeeding step from decade

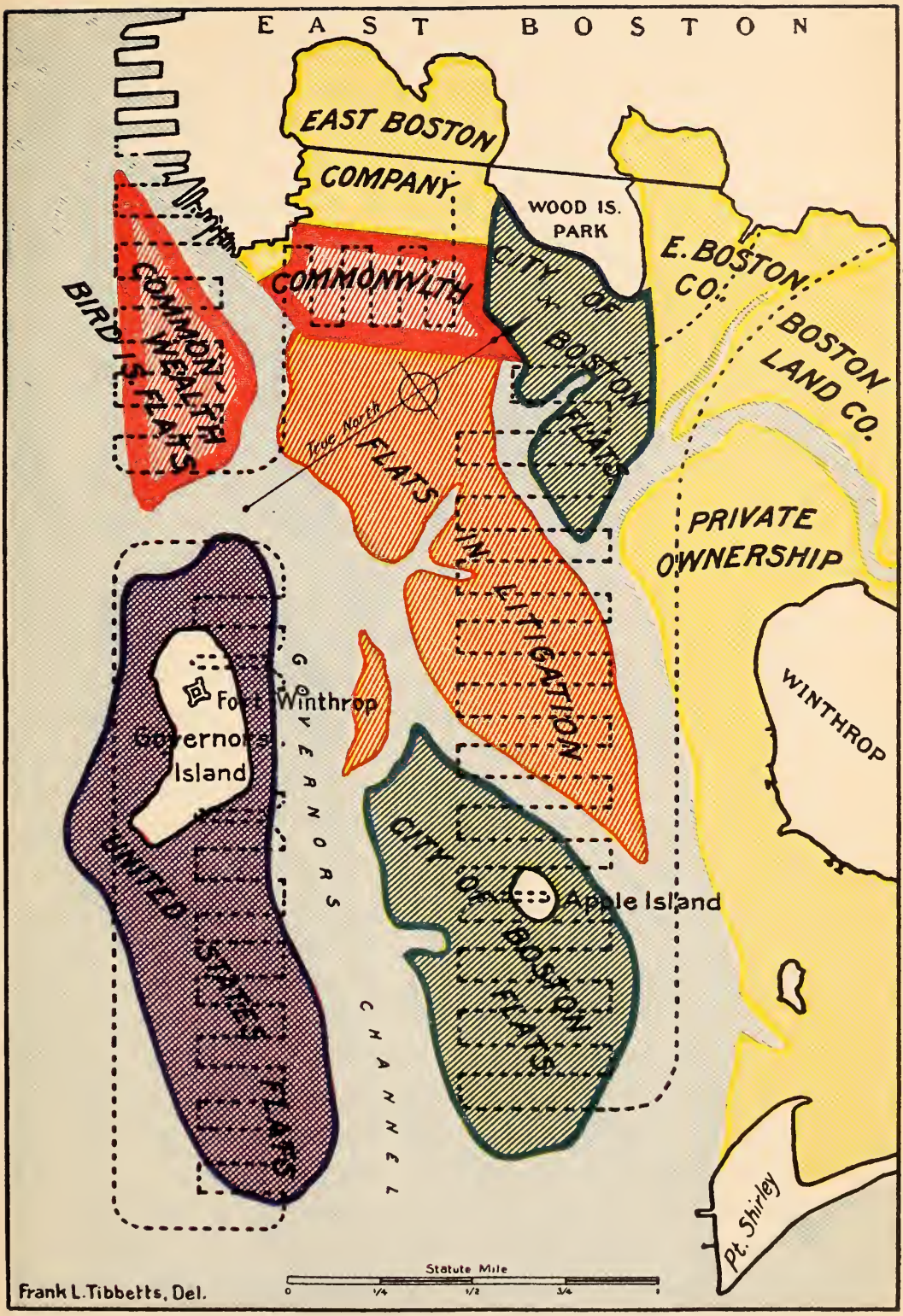
to decade has been a steady growth in these plans, so that now the two cities above cited have proposed improvements which seem almost chimerical. The writer believes, however, after careful examination and study, that this is the true principle upon which Boston must proceed to plan her docks for the future. Even if she does not undertake at once the work of construction, — owing to the fact that some theory of wise organization must be unfolded, — the site may be secured, fortunately, as the writer believes, at small expense, and dedicated to the future development of the port on broad, liberal and practical lines.

Area recommended.

The area to which the writer alludes adjoins East Boston, where convenient railroad connections may be secured with both the Boston & Maine Railroad and the Boston & Albany Railroad. The latter will expand naturally into the area as traffic increases, and a short link, which will be presently described, will connect the Boston & Maine Railroad.

The space includes the flats adjoining East Boston to the east, with Noddle Island and Bird Island flats, Apple and Governor's islands and the flats adjacent thereto, and some of the flats controlled by the East Boston Company. The greater proportion of the area is now owned either by the government, the State or the city, and the title to a portion is now in litigation. The whole area comprises not far from four square miles, and is in brief a magnificent situation for a comprehensive dock system such as will supply the needs of a very large port. It is such a fine situation that it has already attracted the attention of experts, although never on the broad lines here indicated. The writer desires to emphasize the necessity for securing all of these flats at the earliest practicable moment in order that no private enterprise may in the future interfere with the development of public docks. They should be secured at once by the State. The accompanying plan, entitled "Plan of Flats to be taken for New Harbor Development," shows a classification of ownership.

Two plans, A and B, accompany this report, showing how the future port may be developed, although they are intended



PLAN OF FLATS TO BE TAKEN FOR NEW HARBOR DEVELOPMENT

March, 1909. Desmond FitzGerald, Consulting Civil Engineer.

only as suggestions. They are, however, the writer believes, founded on good practice as guided by present experience, but the future only can dictate actual details of construction. The studies are offered for the purpose of pointing out the lines bounding the property, which should be secured as soon as possible and dedicated to docks; details may very properly be left to more thorough consideration.

The site probably includes a number of desirable situations for dry docks on ledge or other stable foundations, although sufficient surveys and data are not now in existence upon which to form accurate conclusions. The inclusion of Governor's Island in the plan does not necessarily mean any conflict with the fortifications or the desires of the general government in connection with their works.

Free Port.

Both plans show a large area, ranging from 523 to 650 acres, to be devoted to the establishment of a free port. This subject has already been discussed by others, notably by Mr. Robert S. Peabody in his recent graphic description of foreign studies, comprised in "A Holiday Study of Cities and Ports." Another Bostonian, the Hon. Charles S. Hamlin, has pointed out some of the desirable features of such a plan for Boston. Free ports are found in several continental cities, notably Hamburg and Bremen. In Hamburg particularly the free port has done much to add to the wealth and prosperity of that wonderful port.

Let us consider for a moment the physical characteristics of a free port in Boston Harbor, and the advantages which it might possibly bring to the Metropolitan District. Whatever its size, it would be surrounded by a fence or other barrier. Inside of that barrier customs would be unknown, although the free port would always be under strict customs supervision. The area might contain docks, warehouses, manufactories, a power house, railway tracks and other accessories, — such as rooms for the display of foreign goods. Here our merchants could examine the goods of foreign manufacture as freely as by making a trip abroad, and order their importations. Raw

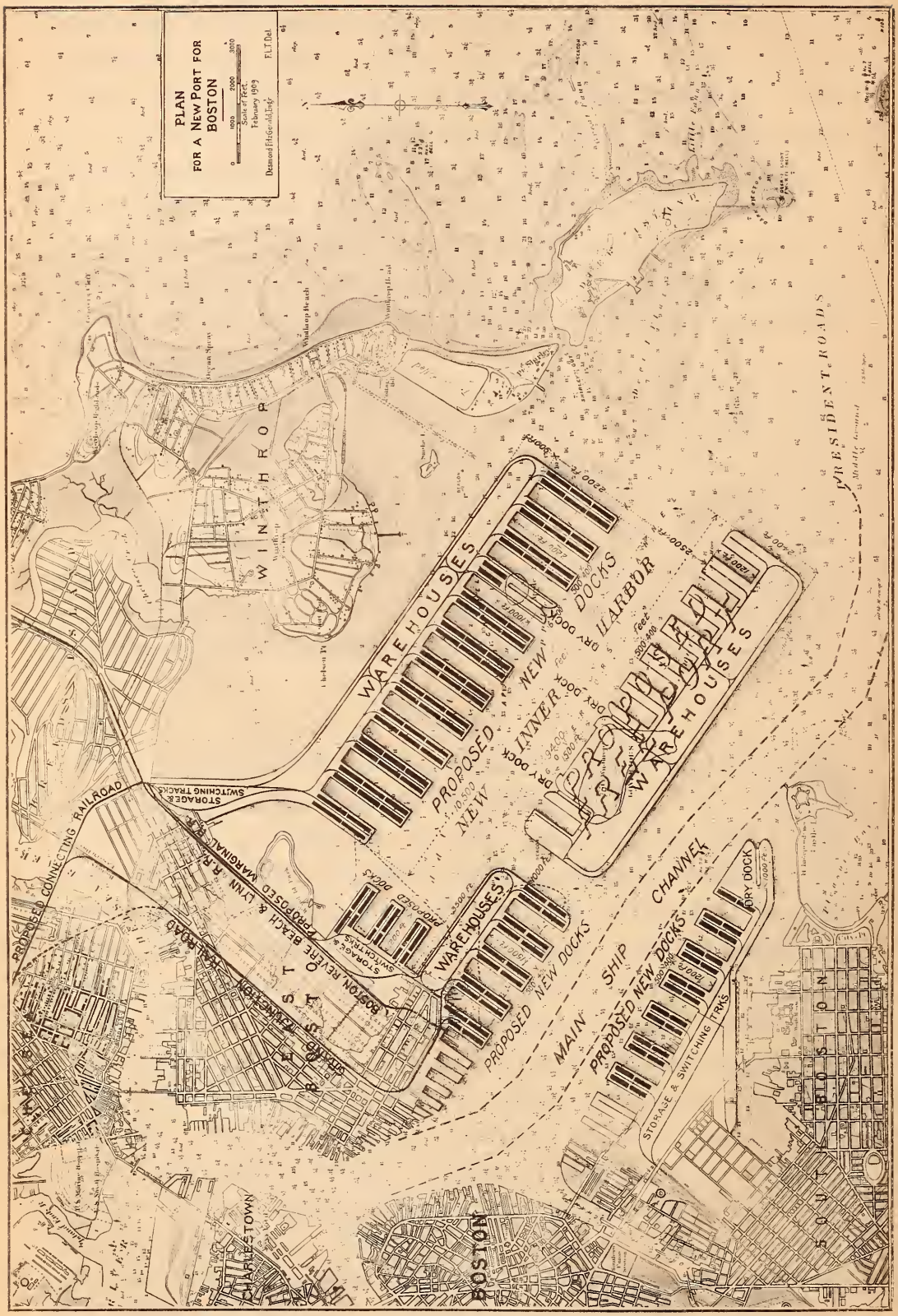
materials brought in free could be manufactured and turned into merchandise for any port, foreign or domestic, and customs collected at the port of entry. The free port would be to all intents and purposes a little foreign nation. Factories would be situated favorably for receiving coal, and for securing other benefits resulting from a position on salt water. A little industrial community would be formed where every modern invention could be brought to bear in the interests of economy and the saving of time. Long hauls by teams through busy city streets would be saved, and handling of raw materials and goods reduced to a minimum.

Before a free port could be established in Boston federal legislation would be necessary. It may be argued that laws now in force permit, by a system of drawbacks, the practical benefits to be secured by a free port, but a study of the subject will show that this is not the case. The present system is a chain of obstacles instead of inducements to the transaction of business; the laws as now formed practically require the bringing of suits to determine the amounts of the drawbacks.

Plans.

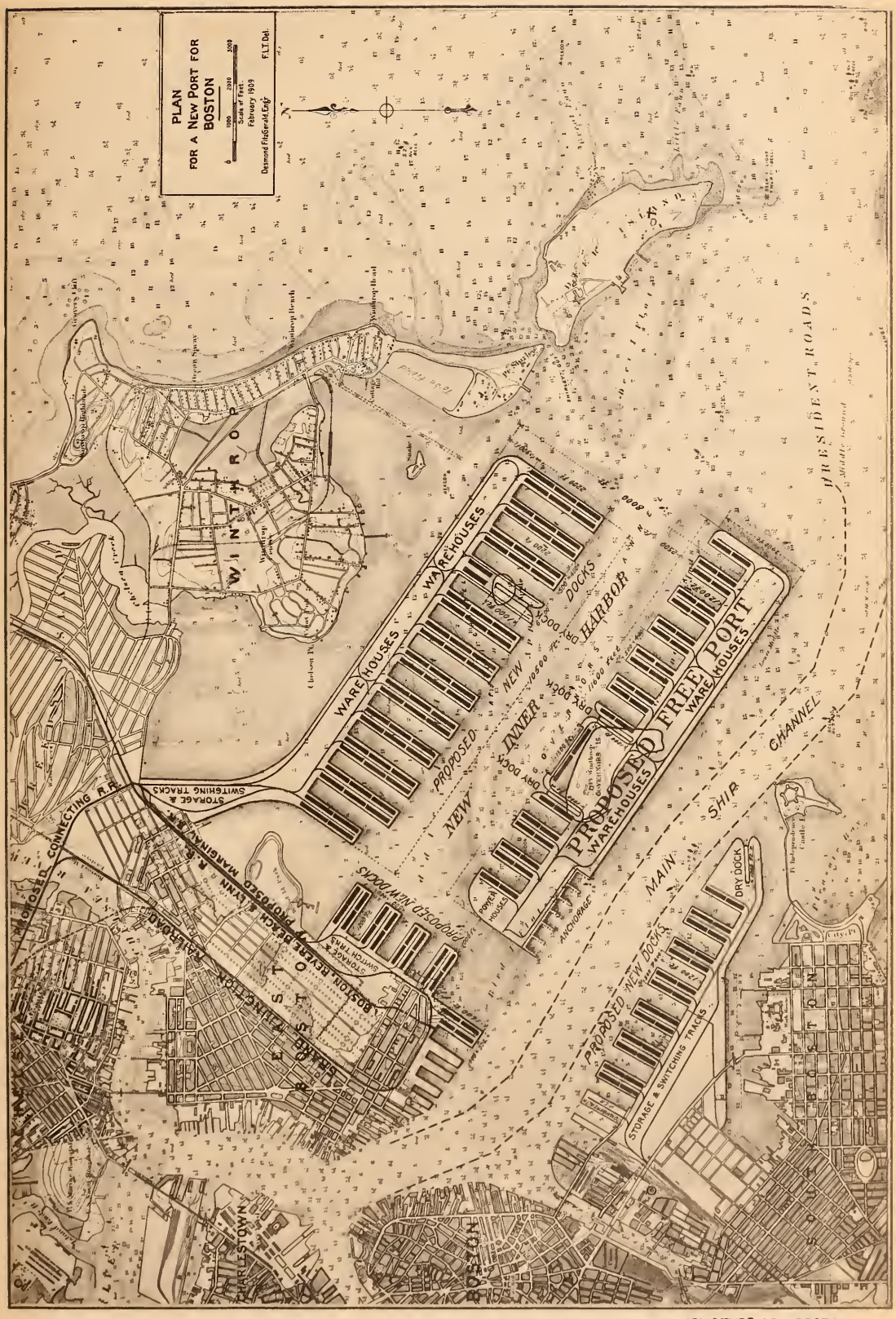
Plan A, the first presented, shows a regular and systematic development of the lines of the future port. It is designed so that small portions may be first built and successive additions made from time to time, as business may demand. The present terminal of the Boston & Albany Railroad at its East Boston docks is continued in a direction towards Governor's Island, and follows a line closely approximating that adopted by the Harbor and Land Commissioners for the construction of an anchorage basin. The docks developed in this extension of the East Boston front, which contains an area of 184 acres, would be very much larger than any of the present docks. They would afford ample facilities for the largest steamers afloat or now in contemplation. The bulkhead and pier lines by this plan would necessarily be changed so as to conform very nearly to the general direction of the channel lines, and yet sufficiently removed to allow of widening the channel in the future should such a project be found desirable. An

PLAN A.



HELIOTYPE CO., BOSTON.

PLAN B.



HELIOTYPE CO., BOSTON.

anchorage basin could be constructed a little farther down the harbor in connection with the area assigned to a free port.

The new docks would have a length of 1,800 feet and a width of 400 feet, and the adjacent piers would be 500 feet wide, with ample room for sheds, roads, and railroad tracks. Marginal Street would, by the plan, be extended across the heads of the new docks, and would naturally be built of sufficient width to accommodate any possible demands for teaming.

Railroad connections would be made in two directions; that to the east by means of a new marginal road parallel with the present Revere Beach line, as far as Trumbull Street, East Boston, where a branch road would connect with the Boston & Maine Railroad, as suggested by Mr. George R. Wadsworth, C.E.; that to the north would be practically an extension of the present tracks serving the Boston & Albany Railroad.

A channel 1,000 feet in width would separate this portion of the proposed dock system from that enclosing Governor's Island. This channel now exists; it would simply be necessary to deepen and widen it by dredging to the lines of the new construction. By means of this channel free communication between the outer and the proposed new inner harbor would be secured.

On the other side of the above channel the southwesterly development of the new harbor continues. The free port area begins above Governor's Island, and after including the whole of that island extends in a straight line to the entrance of the new harbor; it has a total length of 9,400 feet, a width of 2,400 feet and contains altogether 523 acres. The docks which are on the inside of the new inner harbor may be of any reasonable dimensions desired; they have been drawn with a length of 1,200 feet, a width of 400 feet and with seven 500-foot piers between. Ample room remains for factories, warehouses, repair shops, power houses and other necessary structures, and also for roads and tracks.

If this area should be used for a free port it would be favorably situated for isolation from the rest of the harbor. If not desired for that purpose it would be developed in other ways as a part of the dock system. As Governor's Island

has already lost its original importance as a fortification, and its inclusion in the free port area would not interfere with its use by the United States government, it has been treated as a part of the dock system, and this feature would not be devoid of picturesque effects. It is possible that good sites for dry docks may be found on the outskirts of the island, and two have been shown on the plan, subject to future location when proper data have been collected.

On the north, and connected with the shores of East Boston, will be found on the plan 3 docks 1,200 feet by 400 feet, to be built on land of the Commonwealth already secured for this purpose in accordance with the recommendation of the commission of 1895. They cover an area of about 125 acres, and would be served by the marginal railroad already referred to.

The other boundary of the new harbor would form a very large development of docks sufficient for the demands for many years in the future. The lines are parallel to the opposite portion of the harbor, from which they are separated by an open sheet of water 2,500 feet in width. The length of this part of the system is about 2 miles and its width 3,100 feet. It contains 11 docks, with a length of 2,200 feet and a width of 400 feet, the intermediate piers being 500 feet wide. Apple Island will probably provide good foundations for a dry dock, and one has been indicated at that point. Between the piers and the easterly boundary wall is a space of 900 feet, which would contain railroad tracks and warehouses. This portion of the dock system has an area of about 770 acres. It is connected with the East Boston shore by a long neck containing a large railroad yard.

Another feature of the new port may be briefly alluded to. It lies in the long line of dock wall on the northeastern boundary, fronting the Winthrop shore. This long quay can be made to serve various commercial purposes. The shore line itself may also be developed for commercial or manufacturing purposes by dredging and the construction of wharves.

Both plans A and B are free from drawbridges, and have been planned to give access by water to important parts of the natural shore lines.

Plan B resembles Plan A. In it the present dock system of the East Boston front has been turned to the east, so as to take advantage of the existing channel. This results in lengthening the free port to 11,800 feet, more than 2 miles, and in moving the channel connecting the outer and the new inner harbor to the north and nearer the city.

General Observations.

By the plans proposed a new inner harbor would be formed, reaching from East Boston nearly to Point Shirley, its water surface having a length of something more than 2 miles and a width of nearly ½ mile. This area, together with the docks and channels, should be dredged to a depth of 40 feet below low water. The material thus obtained would partly be used for the filling of the piers and other areas. By this method of construction a large harbor can be created at comparatively small expense.

Should the work be undertaken it would naturally be started with a development of the East Boston fronts, and the docks there planned might be reached from the main ship channel without large outlays for dredging. They would serve the Boston & Maine and Boston & Albany railroads for many years; in all cases trains would run directly to the piers.

In view of the many serious conflagrations which have occurred in times past at the docks of Boston it should be unnecessary to dwell upon the importance of slow-burning construction in all future works carried out at the port.

One of the most immediate of the many facilities required in Boston harbor is some well-equipped pier where passengers may be comfortably landed. Such a pier should be built as nearly fireproof as possible, and should contain every modern convenience for the public, — ample shed room, with railroad, trolley and carriage connections, and with permanent and commodious quarters for customs officials. There is hardly any more forlorn position in which invalids or aged persons returning from abroad can find themselves placed than in transferring from steamer to shore with all its attendant delays and inconveniences. These should be reduced to a minimum, and a process now anticipated by many with dread would be trans-

formed into one of real pleasure. Possibly the Commonwealth Pier at South Boston might be adapted to this purpose; it lies in a favorable situation. The writer is aware of the objection of the steamship companies to such a plan. There are some passengers who could not be landed at once, and there are objections to landing at one dock to unload passengers and at another for freight. This is practically what is done at Liverpool, however, where a boat lands its passengers at the great floating stage and then goes to its dock to unload freight.

South Boston.

The plan already suggested by the Harbor and Land Commissioners for the extension of the South Boston dock property has been followed in plans A and B. This property is a valuable one and its usefulness will undoubtedly be demonstrated in the future. The docks are in a favorable situation for coastwise traffic and for purposes requiring close proximity to the city. A suggestion for a site for a dry dock at the easterly extremity has been added.

No attempt has been made to formulate the best way to carry out any of the foregoing work, it being considered best to treat the matter from an engineering standpoint only. It may be pointed out, however, that large dock systems have been successfully developed in other cities under public boards, trusts, committees or other public bodies, and that when it is once considered desirable to take the preliminary steps looking to the inauguration of a great dock system for Boston it will not be difficult to find good precedents for a plan of organization.

Feb. 3, 1909.

APPENDIX.

European Docks.

As I was in France during the summer, it occurred to me that I should take advantage of this opportunity to visit a few of the principal dock systems in Europe, to enable me to form a clearer idea of their bearing upon the problems which we, as a commission, are studying in connection with the port of Boston. Like Mr. Peabody's visit of the previous year, it was entirely a voluntary contribution to the investigations of the commission and without expense to the Commonwealth.

If I were to start with a narrative of the cities visited in natural order, I should begin with the English system, and then take up those on the Continent, but it has seemed wiser to arrange the matter in slightly different order. Out of all the systems there are two which, to my mind, stand out prominently as affording useful lessons to us in planning the future docks of Boston.

These two cities are Liverpool and Hamburg. I might almost omit the first named entirely were it not for the fact that as a system it stands without a rival. Although in its physical features it cannot be used as a model for Boston, owing to a radical difference in conditions, yet in the spirit with which obstacles have been overcome, and in the wonderful example afforded by the organization of the great trust which manages the docks, we have an inspiring model for imitation. I have, therefore, placed these two cities last. I will begin with London, and then proceed to Bristol, Havre, Antwerp, Rotterdam and Bremen, which will in a measure clear the way for the consideration of Liverpool and Hamburg.

London.

London has always been considered as having the largest dock business of any of the ports. Recent analysis, however, shows that the leading position may lie closely between Ham-

burg, Antwerp, Liverpool and London, and that all four are below New York. The facilities for the convenient and economical handling of London's business are, however, very much behind the times. The docks are strung along the Thames, in and below the city; they are overcrowded, rather poorly equipped, and no proper steps have been taken for future extensions.

The reasons are not difficult to understand. The docks have not been under united management, they are dividend payers, the business has been showered upon them, and there has been no incentive to secure trade from rivals. The city itself is such an enormous entity, and with such diverse interests, that the people really know nothing about their docks; they are out of sight and do not enter intimately into the thoughts and daily life of the people, as do the docks of the other cities which we are considering. Partly for this reason they have become somewhat neglected. The great bulk of the imports arriving at the London docks is consumed by the population in and around London. In 1860 these imports amounted to but 6,000,000 tons annually, but had risen to more than 15,000,000 in 1899, and are now very much larger.

After the completion of the Suez Canal the commerce of Europe was revolutionized. Trade was immensely stimulated. The continental ports especially took on a new life, and cargoes which had formerly broken bulk in London were carried directly to Antwerp, Rotterdam or Hamburg. In this way London suffered, but, on the other hand, her own trade increased almost faster than she could take care of it.

I alluded to the poor condition of the London system of docks. This subject has attracted the attention of Parliament, and quite recently a bill has passed providing for the taking over of all the docks, uniting them under a single control, and putting that control in the hands of a board, on the same general lines with the Mersey Dock and Harbour Board, which has done such excellent work in Liverpool. It is called the London Port Authority. The new management will take immediate steps to enlarge the present plant and put it on a more modern basis. The sum of $100,000,000 has been agreed upon as the valuation of the docks.

I was particularly fortunate in making my investigation of the London docks under the general direction of Mr. Brysson Cunningham, one of the principal engineers in charge and well known as the author of a standard work on dock construction.

My first visit was to the Tilbury Docks, which are farthest from London, consequently nearest the mouth of the Thames, the last to be built, the deepest and the ones which first intercept vessels as they come in from the sea. These docks are opposite Gravesend. Vessels enter a small tidal basin through an opening between guiding piers. In this basin, which has an area of 17½ acres, with a depth of 45 feet below Trinity high water, passengers can be landed before the vessel enters the lock; the latter is 700 feet long by 80 feet wide, and is divided into two chambers, one having a length of 555 feet and the other 145 feet. Beyond the lock is a main dock, with three right-angle branches or slips, with a total area of 53 acres and accommodations for about 31 boats each 400 feet long. At low water of spring tides a boat drawing 23 feet of water can be brought into the docks. They were opened in 1886. The distance of the Tilbury Docks from London by highway is 26 miles. As the distance is but 21 miles by the river, goods go to London by water. The width of the widest of the slips is 300 feet. When built it was expected that a large part of the goods would go to London by rail, but water transportation has proved cheaper.

It has been found at the Tilbury Docks that 300 feet is not enough to allow for the width of a model dock; it does not allow sufficient room for manipulation by lighters and I was informed that 400 feet is necessary. The piers, which are 1,600 feet long, were designed for 4 ships, and are now too short for 3 modern ships. There are 2 dry docks connected with the main dock, which are so arranged that they may be used as additional locks. The other accessories hardly demand examination.

The Royal Albert and Victoria Docks, which are united into one system, were to me more interesting than Tilbury Docks. They are farther up the Thames, opposite Woolwich, and about 24 miles from the sea. Navigation on the Thames is difficult

under the most favorable conditions; the channel is tortuous and there is an insufficiency of depth. In addition to these troubles the water is charged with mud, and when allowed to enter the docks causes disagreeable deposits. Many devices are resorted to in the way of sluicing and dredging. Active effort is now directed towards deepening the river to 30 feet at low water as far as Victoria Dock. This dock is 1,050 feet long by 300 feet wide, and has an area of 90 acres; it was opened in 1855; the Royal Albert was added in 1880. The latter is a long, narrow basin, 8,000 feet in length by 490 feet wide, and at the time of my visit was lined with steamers its whole length, loading and unloading. It was one of the busiest hives of industry I have ever seen. It will admit boats drawing 27 feet of water, but this is not sufficient for modern requirements. The arrangement of the quay is as follows: behind the track for the cranes, which is, of course, adjacent to the dock, there are two railway tracks and wide sheds 50 feet distant from the dock, leaving a space in front for the handling of goods. Behind the sheds are three tracks and a street.

Bristol.

Bristol is directly south of Liverpool, from which it is separated by Wales. It is also due west from London and 7 miles up the Avon River from its junction with the Severn. Bristol already has a good dock system adapted to her needs, but has recently branched out into a very large expenditure for an important addition to the old system. The new dock was opened during the summer with elaborate ceremony and was christened as the Royal Edward Dock. It is connected with the old docks, which are known as the Avonmouth Docks. The combined docks are the property of the Corporation of Bristol, and are 6½ miles below the city. Vessels drawing but 16 feet can at high water sail up the Avon to the city docks, which are of minor importance. The mean range of the tide at Bristol is 31 feet and the extreme fluctuations almost 46 feet, which are the largest with which I am personally acquainted.

The Royal Edward Dock is undoubtedly a superb example of an up-to-date English dock. The basin is about 1,120 feet by

1,000 feet, and contains 30 acres of water surface, with 4,200 feet of quay wall. It has a separate entrance from the Severn, with long, flaring, guiding-piers, which provide easy access to the lock. The outside opening between these piers is 700 feet wide, narrowing to 250 feet at the lock. There are three pairs of gates in the lock, worked by hydraulic power, and with such an enormous range of tide the walls and gates are of great height and large dimensions. The depth of water over the sills is 46 feet at mean spring tides and 36 at mean neaps. From the sill to the coping the distance is 54 feet 4 inches. Each half gate weighs 250 tons. The gates, which span an opening of 100 feet, are operated in accordance with the regular Elswich practice of direct-acting rams working through a built-up crosshead and connecting beam to the gate. The fender collision chains are operated by hydraulic winches. The keel posts, miters and sills are of greenheart. The dry dock is 850 feet by 100 feet, and is of excellent masonry.

The double-story sheds are furnished with electric cranes upon the roofs. A feature of this new dock is the opportunity afforded for factories, which may be erected upon land provided for the purpose, with dock and railway connections. This is a feature which is too often overlooked in dock planning.

The Bristol docks are owned by the city and managed by nineteen members of the town council. Money is raised at 2.16 per cent. The business done in Bristol is purely importing, grain, provisions, oil and lumber being the staples. In the Avonmouth Docks there is storage for 8,400,000 gallons of oil.

Havre.

Havre is a brilliant example of the fact that a great dock business does not always follow the most direct lines of communication. As between America and the Continent, Havre is in a position of great strategic value on the map, yet her tonnage is but a fraction of London, Liverpool or the great German ports. The manufacturing districts of England have diverted travel to the more roundabout course. Americans have long been accustomed to visit the Continent by way of Liverpool and London. So far as passenger business is concerned there is a certain undercurrent of thought among students of transpor-

tation which looks forward to a greater development in the future along the lines which bound the English Channel, and the question is asked "What is to be the favorite port in the future? Will it be Plymouth, Portsmouth or Southampton, on the English side? And what can there be on the French side?" As a rule, the perpendicular cliffs along the northerly coast of France afford few good harbors.

It is, perhaps, with a long look ahead that the French government has projected a very large and costly addition to the facilities now existing at Havre. The present docks, like those at Liverpool, lie along the water front of the city, the difference being that in the case of Havre they extend into the very heart of the city itself. One may walk out of the door of his hotel into the cabin of his private yacht. In France all public works of this character are constructed by the government and are built of substantial character and with a regard to the most artistic effect.

This is shown by the careful study given to the finishing of the approaches and surroundings of the docks. The bridges which cross the basins or separate them are of good design and the grades are perfect. Every detail bears the stamp of expert thought. In our own haste we too often leave these matters to those whose training has not given them the best preparation for their execution. In this respect we may learn a useful lesson from the French.

As the average fluctuations of the tide are about 17 feet and the extreme 29 feet, the docks, with the exception of the large entrance basin, or "avant port," are controlled by gates, but in the new works now under way it is intended to dredge the flats to such a level as will give free access to the docks at all stages of water, — in other words, to change the port of Havre to an open port. The new works are planned on an extensive scale, and their cost is estimated at 85,000,000 francs. A new sea wall is to be built far out in the estuary of the Seine, inside of which, and adjoining the old docks, the new harbor will be built.

As the level of the delta deposits is approximately on a level with low water, these flats must be excavated to a depth of 40 feet, and, to provide for a possible deepening in the

future, it is intended to carry the foundations of the quay walls down to a further depth of 10 feet, which means that with so great a range of tide as 29 feet, they will have the enormous height of 103 feet. It is intended to sink them as caissons.

Antwerp.

It has been said that Antwerp is Belgium and Belgium is Antwerp. This city is situated on the River Scheldt, 59 miles from the sea. We have no time here even to glance at the interesting history of the city, nor to trace the rise and growth of its great commerce, nor of the military spirit which dominates its inhabitants. With its record of 11,000,000 tons annually, it now holds a leading position among continental ports. The present system of docks has been practically developed during the past fifty years. Antwerp is unique in being a large railway center as well as a center for shipping.

The dock system of Antwerp is composed of two separate portions which have little in common. One is stretched along the river bank, where the boats rise and fall with the tide, with a fluctuation of 13 feet 4 inches on the average; the other is comprised in a series of basins protected by locks and gates against all tidal or river fluctuations. The Scheldt is a wide and rapid stream at Antwerp, and there are no bridges spanning the current. All of the docks are on the easterly or city side of the river, and, like other ports on these European rivers flowing towards the North Sea, their extensions are always towards the north.

The development of the river front consists of a deep and wide quay wall, extending for a distance of 3 miles. Against the face of this wall large ocean steamers discharge and take on cargoes. At some of the quays the water is 28 feet deep. Close to the boats are lines of tracks and sheds, and there are a number of tracks in the rear of the sheds and adjoining the street which borders the docks. The roofs of the sheds at two of the quays have been turned into a wide terrace or walk, from which there are excellent views of the shipping and the river; it is one of the features of the city. There is some difficulty in maintaining a uniform standard of depth at the river quays.

A very large part of the business is done in the wet docks,

which are about twelve in number. They have been excavated from the earth. Some of these basins accommodate lighters and small boats, and others are designed for the largest class of freighters. By means of gates the water is maintained at a uniform level of about 8 feet below the copings of the walls. The whole cost of the docks in Antwerp has probably been not far from $40,000,000. There is one principal lock and entrance from the river for large boats, but a new one, controlled by three pontoons which are drawn into recesses on the sides of the locks, is nearly ready for use.

There are some interesting traffic bridges over the locks in Antwerp. One of these that I examined is a heavy plate-girder bridge, which is lifted by hydraulic power and rolled back out of the way of the ships. It was built by the Armstrongs and is said to work very well. There are seven dry docks in Antwerp.

In addition to recent improvements to the wet docks, Antwerp has a new and ambitious scheme for development, planned with a far look into the future. It is known as the "grande coupure" or "great cut." The plan involves cutting a new bed for the river across a great bend now existing just below the city, and, in connection with this new channel, building 9 new docks, increasing the water area from 430 to 1,760 acres, and the length of quay walls from 10 to 29 miles. Several of these new docks are planned to have a width of 660 feet and a length of 3,900 feet. The old bed of the river, by means of dams, canals and gates, is to be used as a gigantic basin containing more than 2 square miles of water surface.

It may be thought foolish to spend the time in designing such an ambitious scheme, which may be greatly modified as conditions change, or, in fact, which may never be built at all. But a little reflection will, I think, show that this is not the case. Engineers who have had charge of the development of large dock systems have learned by experience the great cost of acquiring property for building new works where the land has not previously been set aside for that purpose. They have also learned that however large the scale on which they have built in the past, business has outstripped their caution, with the result

that systems developed by piecemeal have lacked harmony and efficiency.

Besides these considerations, there is always a keen rivalry between the different ports competing for the world's commerce, and it would not look well for any of the ports to be behind the others in its plans for the future. Thus we find at Havre, Antwerp, Bremen, Rotterdam and Hamburg very large plans to provide for the growth of trade.

Rotterdam.

Rotterdam and Antwerp are fierce rivals in all matters connected with commerce. So closely alike are the statistics of tonnage that it is very difficult to decide as to which port has the larger business. If Rotterdam stands third in order of rank, as at present seems probable, some sudden turn of the fickle wheel of fortune may at any time advance her to the second place, following Hamburg.

Rotterdam is on the northerly bank of the Maas, the principal mouth of the Rhine, and 18 miles from the sea. When we think of the great difficulties which had to be overcome to make a great seaport of Rotterdam, we cannot but admire the persistent courage which has brought about the results. In the first place, owing to the shallowness of the river, a new and deeper channel across the Hook of Holland was necessary, and, in addition, many of the materials for the docks had to be imported, owing to the absence of quarries in Holland. All of these obstacles have been overcome, however.

At the Hook of Holland the minimum depth of the new Maas Channel is about 27 feet. The fluctuations of the tides on the average are 5.5 feet, and at Rotterdam about a foot less. A very large ocean liner can therefore proceed to Rotterdam on the higher ranges of the tide without passing through locks or gates. It is said that on an average 60 seagoing vessels sail in and out daily at the hook. This deep channel is maintained by means of jetties, sunken dikes and dredgings. It was decided upon in 1863 and was built by the government at a cost of $9,000,000. Some idea of the benefits resulting from the work may be formed when it is recalled that in the old channel

of the Maas a steamer sometimes took from five to eight days to reach the sea after leaving Rotterdam.

The Rhine is a great artery for commerce and Rotterdam is the natural seaport for the Rhine provinces. At her doors the great mass of goods destined for the interior is unloaded into barges and carried up the river for distribution as far as the boundary of Switzerland.

In addition to the quay room along the river, there are 2 large docks on the opposite side of the river, the Rhinehaven and the Maashaven, together with several smaller ones, with a total area of about 500 acres. They have all been formed by excavations from the low lands.

Unlike the docks previously described, those of Rotterdam are entirely open and unhampered by locks or gates. They are adapted to the rapid transfer of ocean cargoes to the smaller Rhine craft. This transfer is principally effected without obliging the steamer to go to a quay. On entering a dock she makes fast to a dolphin, and is quickly surrounded by the barges or lighters, into which the cargo is discharged.

The foundations in Rotterdam are very bad and the history of the quay walls is largely one of failures. This experience has led the engineers to make many useful experiments, both on the bearing power of piles and on different methods of caisson work. The new Waalhaven walls are to be constructed in hollow concrete sections, towed to and sunk on the foundations prepared for them, after which they are to be filled with concrete and sand.

The Maashaven, the largest of the docks, was begun in 1897, but was not completed until 1905. It has an area of 143 acres. On the site at the time of taking were 700 homes, a church and a school. Before the dredging for these Dutch docks can be begun it is necessary to surround the sites with new river embankments before old levees can be cut through, and, in case of the Maashaven, an entirely new town was mapped out as a new suburb to the city adjoining the dock.

To give an idea of the rapid progress of modern commerce, it should be remembered that, at the time of the excellent Massachusetts report on docks made by the Emery Commission in 1897, the great Maashaven dock had just been begun. Now a

new dock more than five times as large is under way. This is known as the Waalhaven. It is situated some distance farther down stream, in the open country. It is to have a capacity for 140 vessels for the transshipment of freight into river boats, to say nothing of the quays on the sides of the dock. In the center an open channel 660 feet wide is to be reserved for navigation.

The planning of this new dock, enclosing 766 acres, is one of the finest examples that I have ever seen of faith in the future, and a firm determination to be prepared for its demands. It was an inspiring lesson to me. A good railway system connects all the Rotterdam docks, but the railways do a comparatively small share of the business. They are not the great freight carriers that they are with us. In 1889 a twenty-five year agreement was made with the railways by which, at the end of the period, the city can take them, at a price to be fixed by arbitration. As a rule all the docks are owned and run by the city.

The Holland-American is the great transatlantic line at Rotterdam.

Bremen.

Bremen is on the easterly bank of the River Weser, 46 miles from the sea. The Weser is a small stream compared with the Rhine, so that we may naturally look for a smaller dock system than at Rotterdam. Bremen is principally known to Americans as being the city to which the passengers by the great North German Lloyd line proceed after the transfer at Bremerhaven at the mouth of the river. The city itself is one of the most interesting in Germany, apart from its docks, on account of its fine old buildings and parks. Bremen boasts a magnificent cotton exchange, for the Bremen cotton market is already hoping to be a rival to that at Liverpool.

The 3 Bremen Docks, like those at Rotterdam, are open at all times. There are no obstructions in the way of gates, but, unlike Antwerp and Rotterdam, there is no development of quays along the city front, the Weser being far too shallow for this purpose, and is also spanned by several bridges. The docks have been excavated from land on the easterly bank of

the stream and are connected with it by an entrance some distance below the city.

Notwithstanding all her disadvantages of situation Bremen is a successful and ambitious city, and has a comprehensive plan for future additions to her dock system. She is also looking forward to the completion of a canal crossing the Weser at Munden, with which she hopes to connect by improving the upper Weser.

Bremen has been a free port from time immemorial, but when the city joined the Customs Union of the German empire it became necessary to isolate the free port from the rest of the city by walls and iron fences, and the necessary works were carried out between 1885 and 1888. The free port includes 2 of the docks, the principal of which is nearly a mile in length and 400 feet in width. Customs officers guard the entrances.

Although the North German Lloyd has a fine office building in Bremen, its real port is at Bremerhaven, which is said to have an advantage over some of the other German and Dutch ports in freedom from serious trouble by ice.

Liverpool.

The docks of Liverpool are by far the finest and most up to date of all that I have visited. They are built of excellent masonry, furnished with locks and gates, and are, when considered together, on such a large scale as to challenge admiration.

They demonstrate what can be accomplished by good management and by following a consistent policy through several generations. A very large part of the city front is occupied by the docks. They extend for a length of 6.5 miles on the Mersey. Their total cost has been something over $200,000,000, and the yearly expense of maintenance is about $8,500,000. The Mersey Dock and Harbour Board is really a great trust, created by act of Parliament. It is purely a borrowing company. As there are no dividends to pay, the principal aim of the management is to maintain the high standard of the works, provide for future requirements and adjust the rates to the total expenditures. During the present fiscal year 25,739 vessels, with a net registered tonnage of 17,111,814 tons, contributed to

the income of the docks. The tonnage should be doubled if outward movements are to be included. The receipts from this source were $6,900,000, of which $3,600,000 were received on vessels and $3,300,000 on goods. The total area of the dock estate is 1,677 acres, of which 583 are in docks and basins. The number of dry docks is 20, with a total length of floor of 2 miles. The largest of these is 930 feet long, and capable of docking the Lusitania.

One of the features of the system is the enormous landing or floating stage at which passengers are accommodated. Its length is 2,478 feet and the width is 80 feet. It is connected to the shore by 8 bridges and by a floating street 550 feet by 35 feet, providing easy access for teams at all stages of water. The average rise and fall of the tide is 21 feet, and this may be increased to 35 feet under extraordinary conditions. Connected to the floating stage is a railroad station for transfer of passengers, with mechanical conveyors for the baggage. This landing stage is the center of interest.

New docks are soon to be built which will admit a boat 1,000 feet long. The depth over the sills will be 46 feet at maximum spring tides. At Lairds I inspected the new dredge building for the Dock Board. It is to have a capacity of 10,000 tons of sand every fifty minutes, and is to cost $750,000. These figures will serve to give a slight idea of the importance of the Liverpool docks. Although all other ports are seeking to divert the Liverpool business, and successfully in several cases, there seems to be enough left to increase the tonnage handled from year to year.

There is much to learn from a study of the details of the plant, with its endless variety of accessories. As a rule, the motive power in common use is hydraulic, that having been proved to be well adapted to meet dock purposes, and very reliable. Some of the newest types of electric cranes upon the roofs of the warehouses are very interesting. The gates, however large, are built of greenheart timber, and some of them have been in use for over half a century. There is railway connection to the docks, but the principal part of the goods is moved by teams.

Although there is little in the construction of the Liverpool

system which is applicable to conditions existing in Boston, there is much for us to learn from the organization and administration. That the works are honestly conducted goes without saying, but in addition to this they are managed with signal ability. It is a liberal education in the control of a large property to visit the immense building in which the different departments have their offices and witness the ease and dispatch with which the affairs of the Board are administered. To keep up with the ever-increasing draft of vessels Liverpool has been obliged to contend against every obstacle. There are dangerous channels of approach where the shifting sand bars have to be dredged, and new docks are constantly under way, or old ones are being changed, to accommodate the demands of commerce.

Hamburg.

Hamburg undoubtedly stands at the head of the list of continental ports. She deserves this rank, not only on account of the volume of her trade, but for the excellent facilities she provides, and for the system and order which she maintains throughout the port. The docks afford a very good example for an American to study because the tidal fluctuations approach nearly to our own Boston conditions, consequently the basins are entirely unobstructed by locks or gates, and also because they are cleverly designed, thoroughly built and most carefully and honestly administered.

In order to understand clearly the reasons for Hamburg's greatness it is necessary to appreciate her wonderful topographical situation. She may be called the queen of the Elbe. Although 65 miles above the mouth of the river, she is just at the favorable point where river traffic naturally ends and ocean traffic begins. The Elbe, below Hamburg, is for many reasons difficult of navigation by small craft, and yet on account of many improvements to the stream, comparatively large boats, though not the largest, can ascend as far as Hamburg. If the river craft could have battled successfully with the lower Elbe, Cuxhaven, instead of Hamburg, might have been the great port. In fact, the upper Elbe boats are so hard to steer that they enter the docks through special entrances, so as not to

encumber the river. If we examine the map of the German coast, we shall find at a short distance easterly from the Elbe that the Peninsula of Denmark rises straight to the north, extending almost to the Swedish shore, from which it is separated only by a narrow and tortuous channel. The Elbe, therefore, is the easterly limit of free ocean navigation. There are, to be sure, ways for getting into the Baltic, but to the mariner they do not take the place of the open sea.

Hamburg, therefore, is the great receiving and classification yard for the business of the Elbe. Here goods are taken out of the steamer and put into barges and lighters for distribution in the interior of Germany. The Elbe is the trunk line for commerce, taking the place of our great freight-carrying railroads.

The first view of the Hamburg water front is novel and bewildering. All sorts and conditions of boats move over the waters. Thousands of barges are here gathered together, and besides the larger vessels more than 700 small tugboats dart actively about in every direction. The impression produced upon the eye is that collisions are constantly imminent, yet they seldom occur. Canals penetrate the city in every direction, and upon the opposite or westerly bank of the river open the larger docks.

The area of all the basins is about 1,200 acres, and the cost of the entire system was about $70,000,000. The average rise and fall of the tide is 6 feet 3 inches, rather more than at New York and less than at Boston. Exceptional freshets increase the range to 15 feet. At low water there is generally a depth of 26 feet of water in the docks; but this is not enough for the demands of commerce, and, although at high water there is a depth of 35 feet as far as Hamburg, there are so many troubles from sand-bars and shallows in the river, to say nothing of ice, that the largest steamers dock at Cuxhaven, near the mouth of the Elbe, where passengers are transferred to Hamburg. Two hundred years ago the Elbe was but an artificial ditch in front of the city, but through this ditch the greater part of the river has since been trained to flow.

Before we take the ferry for the other side of the river, we examine the large new floating stage which is nearing com-

pletion. This is built on the same general lines with that at Liverpool, and connected with the quay in the same manner. At this stage steamers are unloading and taking on passengers almost continuously.

On the left hand of the river one may spend several days in studying the docks. Some of them are arranged entirely for river traffic. One that I visited was leased by the Standard Oil Company. The entrance to this dock was provided with a permanent dam, with the exception of the center section, which could be swung into place at a moment's warning, thus isolating the dock from the rest of the system and preventing the spread of fire by oil. The only gates that I saw in the Hamburg system are provided for the control of the currents and to confine them to the river itself. These gates are lifted for the passage of small boats. The Hamburg-American line also has its docks, and they are the largest in Hamburg. The great business done by this line may be realized when it is remembered that it owns 400 vessels. The equipment is very fine. Several enormous sheds are under its control, to say nothing of other large buildings necessary for the administration of its business.

At Hamburg will be found a great variety of piers and docks adapted to the various demands of commerce. The best of the piers are provided with streets. On either side of these streets are several lines of railroad tracks. Then follow the sheds, which are of sufficient length to accommodate a modern boat. These sheds are one story in height, are provided with electric cranes on the water side and smaller hand cranes on the street side. On the water side the sheds are supplied with good platforms, and at these platforms is a line of tracks; then follows a wide space for handling goods as they are unloaded from the boats, and on the edge of the docks a line of tracks for the cranes. One leg of the crane spans the space in front of the shed and rests upon a track attached to the building near the roof line.

A very large part of the business in the docks and in the steamers at Hamburg is handled without obliging the boats to come to the quays. In the middle of the docks are large

clusters of piles, called "dukes of Alba," at which steamers or sailing ships may moor, and here they may quickly unload by their own appliances into barges or lighters which surround them. In this way there is no charge for the sheds or quays, and a large amount of business may be economically and quickly transacted. There are 5,759 barges employed in Hamburg, and they handle the bulk of the business. All of the docks are provided with railroad connections, but only about 18 per cent. of the business transacted at the quays is handled in this way. Carts take care of about 20 per cent. and 45 per cent. goes by lighters directly to goods stations. On the right bank of the river are three fruit sheds. These are provided with special means for ventilation. Nearly all of the Hamburg docks are included in the free port. As is well known, Hamburg is not only a city; it is also a free and independent State, just as Prussia is independent; she joined the Customs Union in 1883, and was then obliged to isolate and guard her free port. There are but a few places where goods can enter or leave the free port and these are properly protected. Oversea traffic is entirely confined to the free port. The total tonnage of the port is 12,000,000.

Nearly all of the works that I have described were constructed by the city-state of Hamburg. They are managed by a Deputation for Trade and Shipping; over the docks that are leased the city keeps a strict oversight, and they are not allowed to do anything which would compete with the government business, — that is, they cannot enter into combinations outside of their own legitimate business. One very remarkable fact in connection with the official management is that on the government docks there can be no special favors granted; every one is served in turn. The city furnished the ground, canals, walls and streets, and then a company, which now exists, built the warehouses. The following is the basis of financing of this scheme: —

Firstly, the company gets 3½ per cent. on its investment.

Secondly, the city gets the next 3½ per cent. on its investment.

Thirdly, the shareholders get 1½ per cent.

Fourthly, the city gets 1½ per cent., which is to be invested in shares, drawn by lottery so that in the end the city will become the sole owner.

I could not help feeling while in Hamburg that a large part of her success is due to the honesty and enterprise of her people. As you walk the streets you are impressed with the quick and alert movements of the inhabitants. In the latter respect they closely resemble Americans.

November, 1908.

The Metropolitan Plan.

BY ARTHUR A. SHURTLEFF, LANDSCAPE ARCHITECT.

In pursuance of the request of the Metropolitan Improvements Commission I have made during the past eighteen months a field examination of the road lines of the Metropolitan District [1] in order to learn their merits and defects and to consider the feasibility of making organized improvements in them. In the following report I beg to submit the results of this examination arranged under these headings [2]: —

The Highways of the District as a Whole.
Radial Thoroughfares.
Circumferential Thoroughfares.
The Local Street Systems.
The Width and Gradient of Streets.
The Relation of Streets to Public Parks and Parkways.
Squares at Traffic Centers.
Conclusions.

I also beg leave to submit, in the appendix of this report, a brief statement of the more important street improvements needed for each community in the district.

[1] A territory of approximately 400 square miles, embracing the 39 cities and towns of the Metropolitan Parks District, together with Lexington.

[2] Park problems, grade crossings, street pavements, sidewalk construction, sewers, water supply, and many other matters aside from the strategics of the highway problem, are not considered in this paper.

The bewilderment of strangers who view for the first time the unusual street system of Boston and its vicinity should be a matter of little concern to our citizens. The simple gridiron of uniform streets with which most American cities are laid out was not applicable to the steep, isolated hills, radiating valleys and irregular shore line of this district. Had our streets been planned in the beginning by a designer who could have adjusted a simple arrangement of highways to an exceedingly involved topography, and to the independent tastes of a frontier of scattered villages, we might enjoy to-day a system of thoroughfares which could be comprehended readily by strangers. It is open to question whether such a plan could have been produced or carried out, or whether it would have served the district well in all respects. A discussion of this question is aside from the mark. We are vitally concerned with street problems clearly evident to ourselves, whether they are seen by strangers or not. Our citizens as a whole complain of faults in our system of highways which waste the time and strength of man and beast, seriously hamper the transaction of business, interfere with the development of the water front, prevent the construction of convenient street-car lines, and isolate communities from one another. Can we expect home industries to thrive as they should or new industries to seek us to the extent that they might while this faulty situation continues to exist, and has never been taken in hand by authorities properly constituted to rectify it? The district has faced similar problems and has solved them in a workmanlike way; it has provided itself with comprehensive systems of metropolitan water supply, trunk sewers and parks, which are accepted as models; certainly no community knows better the method by which co-ordinated highway improvements may be effected.

It should not be supposed, however, that the highway system of the district is a mere tangle of streets arbitrarily placed, without regard to usefulness and impossible of correction. On the contrary, the system comprises a singularly logical group of highways which with few exceptions were laid out wholly for convenient use, and which, by virtue of the symmetry of the Boston basin, have attained a remarkably even distribution. Only in the more densely settled portions of the community are

these highways incapable of adjustment to modern needs. In the district at large improvements may be carried out at a cost small as compared with the advantages to be gained, and with no greater physical difficulties than have been overcome time and again in local highway changes.

To present these facts more fully is the purpose of the following considerations.

The Highways of the District as a Whole.

Upon a map the streets of the district present so complicated a network that their chief characteristics cannot be discussed readily without the use of diagrams, to classify the main thoroughfares and separate them from the purely local streets. The main thoroughfares may be divided into two groups, — those which radiate from Boston into the suburbs, and those which sweep in arcs or in a series of tangents about Boston, connecting the suburbs with one another and with the shores of the harbor and bay. As a whole, the radial streets forming the first group are evenly distributed and form a nearly complete system of wide and direct thoroughfares having good gradients, while the circumferential or transverse roads forming the second group are narrow, ill-connected and abound in steep gradients.

This greater network of main thoroughfares [1] is subdivided by an intricate mesh of local streets, generally arranged in an approximate gridiron pattern oriented by the nearest radial road leading to Boston.

Radial Thoroughfares.

When Boston was first settled by the colonists it became a center from which trails led into the inland country. At points upon these primitive thoroughfares favorable to water-power development and farming operations other communities sprang up, first deriving their supplies from Boston and later sending

[1] Among these main thoroughfares of both groups there are certain parkways, boulevards and avenues which are distinguished from the other highways by generous width, easy gradients, special electric car reservations, agreeable tree planting and by remarkable continuity in spite of winding courses. These great thoroughfares were methodically planned. Though they are largely restricted against traffic use, and are to that degree aside from the primary purpose of this study, they show in a forcible manner the admirable results which may be expected of roads systematically planned to be of service to the district as a whole.

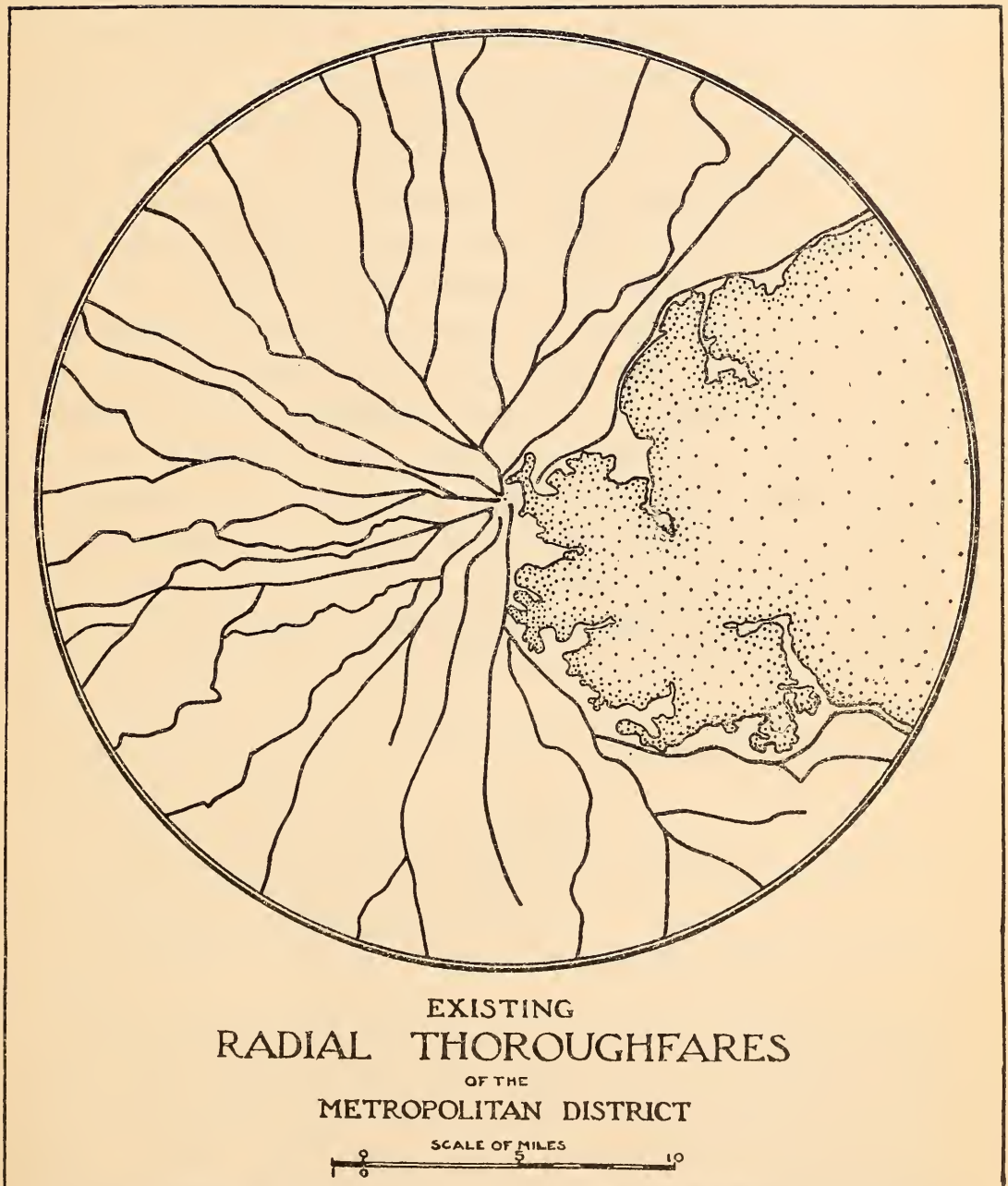
products of their own to Boston to be sold or shipped to other ports. The success of these villages depended wholly upon their relations with Boston, and there was consequently little cross-country communication between the several dependent villages. Boston was naturally a center of trade and social influence. All roads, therefore, led to Boston.

The order in which the suburbs were settled, and their business and social dependence upon Boston, partly explains the remarkably regular system of radial roads which connect Boston with the inland country. (See diagram opposite this page.) Boston also occupied a topographical center toward which three rivers and many tributary streams converge, offering through their gently inclined valleys favorable passages for roads to the hill country. The configuration of these highlands and the in-curve of the seashore also contributed singularly to the symmetry of the Boston basin. That a nearly symmetrical although naive system of radiating highroads should have resulted from a combination of these social and physical conditions is natural, and it is fortunate. No other roads could have been so easily built or could have become so useful. (See map opposite page 256.)

Decade after decade these roads were widened and straightened, while the villages upon their borders grew into towns, and local streets were built approximately parallel and at right angles to the parent road. Naturally enough the first permanent buildings in these towns clustered upon this main road, and in the course of time these structures fixed its position and its width absolutely. In certain communities, among which may be mentioned Wakefield, Lexington, Waltham, Quincy and South Quincy, unusual width was provided for the main road, partly out of regard to its distinguished service as a thoroughfare, but more especially to allow comfortable space for teams to tie up alongside the country stores. This provision has maintained the efficiency of the main roads of such towns to accommodate through traffic and local trade.

In other communities,[1] among which may be mentioned

[1] As the map opposite page 256 indicates, the majority of the radial streets are wide, but the exception should be noted. A discussion of minimum street widths is given on page 199.



This map shows upon a small scale the existing radial through roads of the district, which are plotted in blue lines upon the first map opposite page 256. The distribution of the roads forming this system of main highways is astonishingly uniform, although each road, with hardly an exception, was built without regard to a general scheme.

Malden, Melrose, Woburn and parts of Weymouth, the main thoroughfares were not sufficiently widened. As a consequence, traffic difficulties are arising which not only affect these municipalities unfavorably, but which tend seriously to impair the usefulness of the main road to the neighboring towns dependent upon it. For example, the narrowness of Main Street in Malden is a hardship to Wakefield, Stoneham and Melrose upon the north, and to Everett, Charlestown and Boston upon the south, inasmuch as the difficulty of passing through this narrow, crowded thoroughfare cannot be obviated readily by following any other direct route. Similar conditions exist in Lynn, Swampscott, Revere, Charlestown, Medford, and in many other localities, including, as we well know, Boston proper. These conditions are not stationary, but form growing evils throughout the district; many communities upon the main radial thoroughfares are only now just beginning to add sufficient local traffic of their own to the through traffic of these roads to render them inconvenient. Among such communities may be mentioned West Medford, Cliftondale, Linden, Needham, West Roxbury, Braintree, portions of Weymouth, Cohasset and Nantasket village.

The general means of relief from these conditions may be classified as follows: —

1. Widening the main thoroughfare.
2. Relieving the main thoroughfare by diverting a portion of its traffic into a nearby local street.
3. Creating a new and ample thoroughfare upon a new location.

It is reassuring to observe, by an examination upon the ground, with what readiness the traffic difficulties of the radial roads may be overcome in the outlying towns by one or the other of the above means. Opportunities for carrying out improvements of this character exist to-day in the suburbs as they existed in Boston proper years ago, when we were too inexperienced and too short-sighted to seize them. Boston should take care that its own history is not repeated in the district at large. The towns and cities of the district using Boston as an object lesson may well co-operate in protecting themselves from so expensive

and short-sighted a course of self-injury. The situation cannot and need not be cured at once. An organized movement for correction should be begun at once, however, to bring about the needed improvements gradually, thriftily and with surety, in the order of their importance.

Although the radial thoroughfares sought the valleys where road construction was the easiest and the slope of the ground most gentle,[1] nevertheless many obstacles were encountered and surmounted by them. Rivers had to be bridged, small hills[2] cut down, hillsides terraced and miles of causeways constructed over tidal marshes. As this work was expensive it was not undertaken faster than it was actually required; improvements of this kind have been in progress ever since the district was settled, and many still remain to be effected. At present there is need of a new road near the water front leading southward from Boston toward Quincy, forming an extension of Old Colony Avenue. This improvement is described on page 226. A similar amplification and extension of the radial road system is needed between Revere and Lynn, and is described in detail on page 240. No immediate need exists for a radial road through the vacant sector of Brookline which forms a conspicuous open space in the highway system.

Circumferential Thoroughfares.

The topographical and social influences which led to the creation of the remarkable radial thoroughfares tended to hinder and to delay the construction of roads connecting the communities with one another across the district. The towns were separated from one another laterally by lines of hills, by

[1] The straight turnpike roads, built in later times over hill and valley, without regard to gradient, do not belong to this period of rational highway building.

[2] The map opposite page 256 indicates the position of severe gradients occurring in the radial highways where hills are encountered. Though such hills are of small importance to light, rapid-moving vehicles they are the most serious obstacles which can confront heavy traffic. Where short stretches of bad grade are present, — as at Broadway, Revere, and at the junction of Beacon and Chestnut streets in Newton, — the gradient can be reduced most cheaply by cutting down the hill itself; but the same object can be obtained only by a detour of the hill when a severe gradient is long continued, as along Broadway in Everett and along Newton Street in Weston, where a complete relocation of many portions of the road is necessary. Similar relocations of highways are needed in many other portions of the outer district to secure proper gradients. (See Dover, Lexington and Woburn, in appendix.)

rivers and often by extensive swamps, which were sufficient obstacles in early times to hold cross-road construction in check. As the towns increased in size, however, roads were built from each town to its nearest lateral neighbor, but without regard to the use of these highways as through routes for other towns lying at greater distances. It should be observed, however, that these link roads followed courses nearly at right angles to the nearest radial thoroughfare, partly because they were extensions of the cross streets of each town and partly because the towns themselves were distributed in groups at about equal distances from Boston. The distribution of groups was partly a result of chance and partly a consequence of the topographical symmetry of the basin. Consequently the circumferential or transverse roads possess a degree of continuity and a certain symmetrical arrangement. They indicate the courses of least resistance upon which adequate cross-district roads may be developed.

The unimportant part played in early times by the cross-district lines shows the relative unimportance of the individual towns as compared with Boston at that period. Boston was almost literally a hub and the towns figuratively clung to its spokes. The situation is now changed; the suburbs have grown so large and self-centered that they no longer depend wholly upon Boston, but have become in their turn radiating centers. This tendency is shown not alone by the increased use of the few cross-district highways, but by the increased use of the radial lines. These converging roads constitute a species of funnel which forces cross-district traffic through Boston, because there are no convenient side outlets by which vehicles may go around the city. Traffic of this kind is of no benefit to Boston, but clogs its streets. To force the traffic of the north and south halves of the district through channels no more ample than Devonshire Street (48 feet wide) and Exchange Street (24 feet wide), and over the Harvard bridge, the latter having no good northern connection, is an absurdity.

Lack of adequate connection is present on every hand. The Cottage Farm bridge has no good southern outlet; Brookline has no satisfactory connection by road with Cambridge, or Cam-

bridge with Malden, or Malden with Revere; Winthrop is cut off from Revere by the impossible gradients of Beachmont; north shore traffic may enter Lynn only at peril through the crowded and narrow Humphreys Street; Needham is cut off from West Newton except for vehicles which can climb the severe gradients of Chestnut Street. Each town has a cry of distress, and yet all are helpless, because only with extensive co-operative action among the towns could improvements be assured worthy of the expenditure of money. It remains for the district as a whole to provide this co-operative possibility.

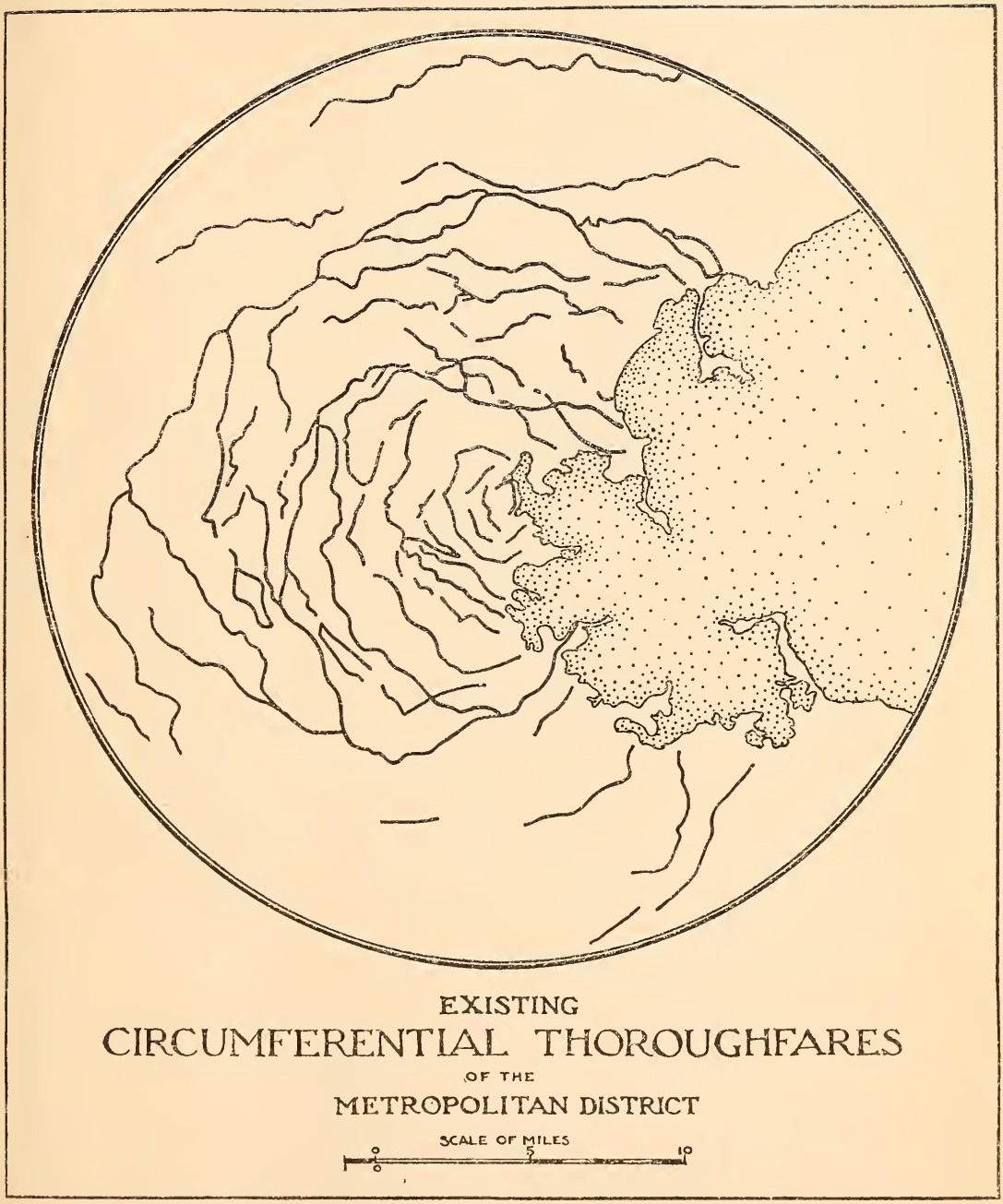
Of late the inconvenience of these cross lines has been brought to public attention in a new form by the automobile. This type of conveyance has vastly increased the range of individual movement, and has discovered and advertised abroad the weak points of our highway connections. Power vehicles for the delivery of goods have also greatly enlarged the radius of local express movements over the highways, and are demanding more convenient connections across country.

The ease with which the cross-district lines may be connected and widened is astonishing to one who studies the problem in detail upon the ground. Seemingly providential opportunities are presented at each juncture.[1] Even in the built-up portions of Boston between Massachusetts Avenue and Milton Lower Mills there are incipient lines of communication which connect admirably with the water front on the east and with other incipient through lines on the west.

If the district continues to grow as it has grown in the past the day is not far distant when the local street systems of the municipalities will knit together to form one great fabric. If that fabric should have in it no continuous warp of cross lines, in how miserable a net would the district be strangled! That such improvements would be costly is apparent, but the return they offer is worth the cost. In fact, the district cannot prosper as it should unless its main thoroughfares are set right.

Within the limits of this report it is only possible to show two large scale plans for the development of the existing cir-

[1] See map opposite page 256, which shows the position of these cross connections.



This map shows upon a small scale the existing streets, which are colored in blue upon the second map opposite page 256. These roads, taken as a whole, form the present cross-district system of highways. Their symmetrical distribution is notable, especially in view of their failure to make through connections, and illustrates the remarkable opportunity which the district possesses to create, by their co-ordination, an orderly and efficient system of circumferential thoroughfares.

COMMONWEALTH OF MASSACHUSETTS

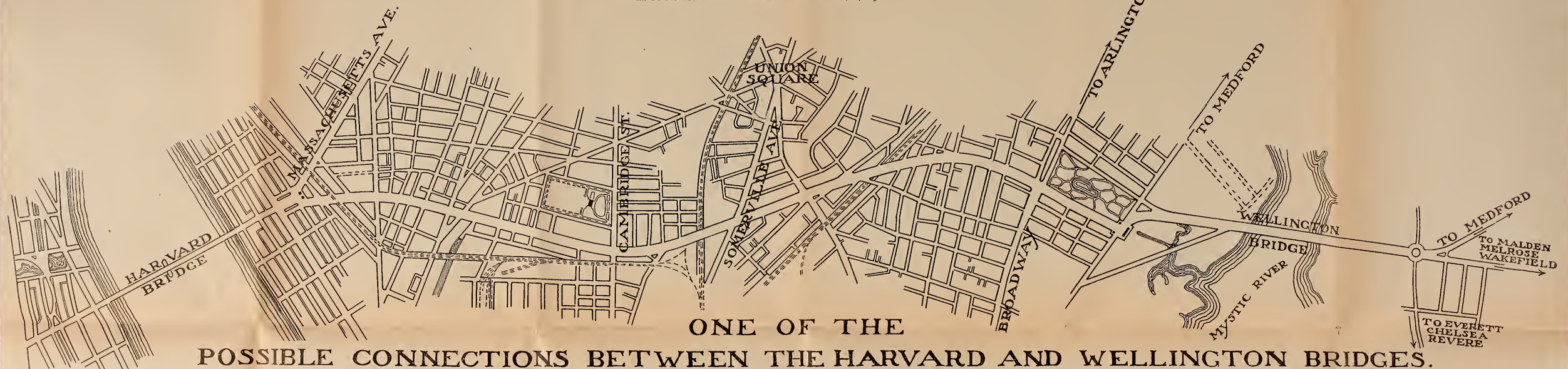
METROPOLITAN IMPROVEMENTS COMMISSION

SCALE

0 1/4 1/2 3/4 1 MILE

ARTHUR A. SHURTLEFF
22 CONGRESS STREET.

LANDSCAPE ARCHITECT.
BOSTON, MASS. JAN. 28, 1909.

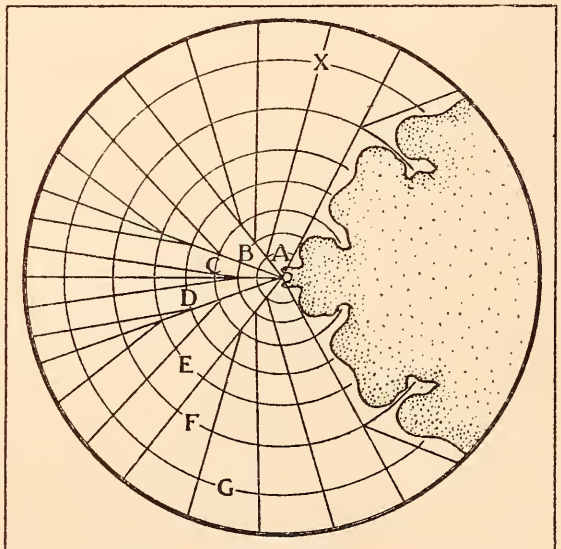


ONE OF THE

POSSIBLE CONNECTIONS BETWEEN THE HARVARD AND WELLINGTON BRIDGES.

EXISTING STREETS BETWEEN THE HARVARD AND WELLINGTON BRIDGES

Having indicated the general characteristics of the existing radial thoroughfares, and of the incipient circumferential thoroughfares, it remains to be shown that a combination of these two types of main roads when perfected would afford an efficient system of inter-communication for the district. The diagram shown below indicates in a purely schematic way the combination of a series of radial and circumferential lines comparable with the ultimate development of the existing and proposed thoroughfares of the district, with all local streets omitted. The absence of the more intimate connections which are actually afforded by these local streets places the diagram at a disadvantage, but it suffices to indicate the readiness with which a vehicle at any point, such as X, may proceed to any other points, such as A, B, C, D, E, by a variety of alternative routes. In fact, this combined scheme of radials and circumferentials which the district has been slowly approximating in a wholly unconscious manner during the last two centuries offers a system of intercommunication more direct than that which could be afforded by a rectangular gridiron similar to those which characterize the plans of most American cities. It should be frankly admitted, however, that—in a decidedly minor aspect—a rigid gridiron scheme, like that of San Francisco, Chicago and Philadelphia, has at least one point of superiority over all city plans containing many diagonal lines, like the plan of Washington and Boston, or containing many curving lines, like Paris and Boston. This superiority lies in the fact that strangers may readily find their way in such uniform gridirons. To such strangers the streets of Boston and the Metropolitan District promise forever to be a puzzle, but, on the other hand, these thoroughfares also promise to become more convenient for everyday use, more individual and more free from monotony than any other street system in America.



SCHEMATIC
DIAGRAM OF THOROUGHFARES
OF THE
METROPOLITAN DISTRICT

cumferential roads. Of these plans[1] the one opposite page 194 shows a proposed new thoroughfare between the Harvard bridge and the Wellington bridge to connect the northern and southern halves of the district in a region where the present connections were well known to be inadequate. The plan opposite page 222 shows a similar proposed thoroughfare, to lead from Barry's Corner in Allston through Davis Square, Somerville, to Powder House Square, by which another desirable cross-district connection may be effected.

The Local Street Systems.

The present condition and the future possibilities of the main thoroughfares of the district cannot be fully understood without a consideration of the local highway systems of the individual towns. In the past the local street systems were derived from the main thoroughfares, but in the future the success of the main thoroughfares must depend very largely upon the wisdom with which the local street systems are developed.

The local street systems[2] are made up of 39 parcels of local streets, belonging to the 39 cities and towns of the Metropolitan District. Since each municipality, largely independently of the others, has planned its own scheme of streets, a great diversity in plans has resulted. At first sight these individual street systems seem to have little in common, but upon examination they are found to be similar in many respects.

Most of the cities and towns of the district were laid out upon approximate gridiron patterns, modified in commendable ways to follow irregularities of the ground, to agree with arbitrary property lines and to accommodate themselves to eccentricities which cannot be readily analyzed. Almost without exception

[1] These two plans do not attempt to indicate the best route or the many alternative routes upon which these two roads may be built. To show such routes would perhaps invite unscrupulous persons to buy land upon the proposed lines of improvement in the hope of reimbursing themselves handsomely by winning damages. These plans are publicly shown with the knowledge that they indicate only in a general way the course of the needed thoroughfares, and that they do not represent the final lines of construction upon which such improvements might be carried out with the greatest economy or with the most acceptable appearance.

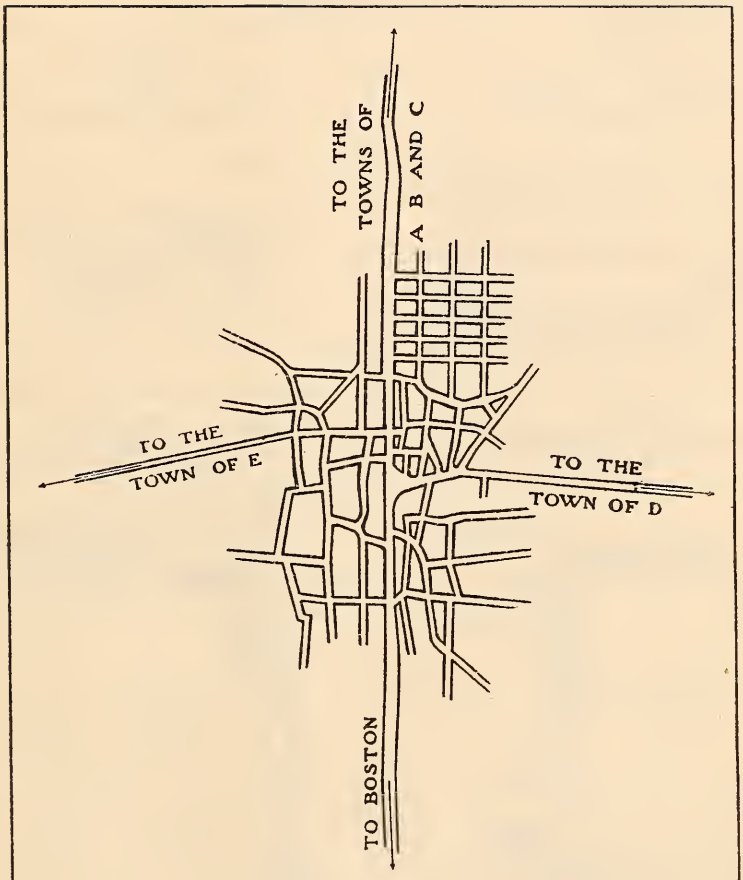
[2] The authorities in control of the local streets of the cities and towns are described, with their powers, on page 257.

the most important street of each gridiron leads directly towards Boston, and consequently orients the entire layout of the town.[1] The street of second importance is usually a cross street to the nearest side community. The individual streets forming the gridiron also have common characteristics; generally speaking they fail to make a through course, and lose their alignment in jogs and dead ends. This characteristic is of some importance to the individual municipalities, but to the district at large it is a serious matter, for it effectively prevents the secondary local streets (of good gradient) from relieving either the main radial street or the main cross street from congestion. It also prevents, in the future growth of local street systems, the automatic creation of new radial and circumferential thoroughfares necessary to the convenience of the towns themselves no less than to the district. The accompanying diagram of a typical town illustrates this condition, which is common to Lexington, Malden, Melrose, Everett, Waltham, Watertown, Weymouth, Brookline, and almost every other city and town of the district. In Boston this fault appears familiarly in the failure of Merchant's Row, of Broad, Kilby and Congress streets to carry across State Street. This species of deformity has been the source of such inconvenience and of such waste effort in Boston that the district at large should adopt measures to correct it in the cities and towns before the upbuilding of their side streets with permanent buildings has progressed too far to allow a correction to be made at reasonable cost. It should be the duty of some metropolitan authority to assure these improvements by demonstrating to the local communities their importance, and by carrying out the reform gradually as an integral part of a co-ordinated scheme of long-sighted improvements.[2]

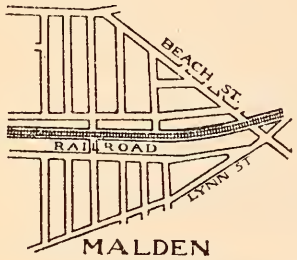
There can be no question of the picturesque value of jogs, dead ends, elbows and other irregularities which lend individuality to many street systems. These departures from strict uniformity, while affording a welcome variety in the prevailing

[1] The angles of the successive gridirons swing in regular order through successive points of the compass from Lynn to Hingham, and cover approximately 315° of arc.

[2] Another common characteristic of the towns is the presence of amputated or rudimentary streets terminating in dead ends upon the borders of railway property and along river and pond borders. (See figs. 17, 18, 19 and 20.) In the city of Malden and in Waltham this



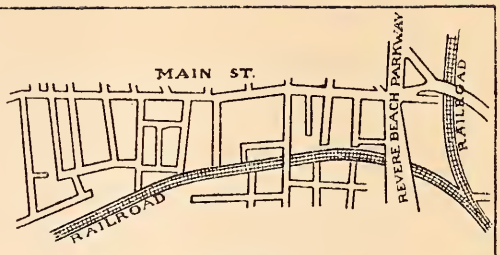
A TYPICAL TOWN
OF THE
METROPOLITAN DISTRICT



MALDEN

FIG. 17

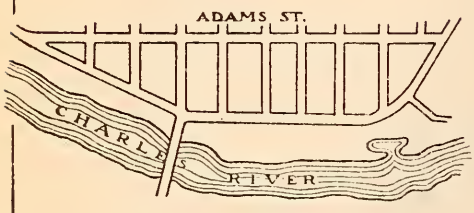
WELL ARRANGED STREETS
NEAR RAILROAD



EVERETT

FIG. 18

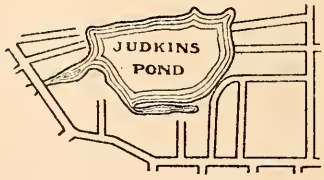
BADLY ARRANGED STREETS
NEAR RAILROAD



WALTHAM

FIG. 19

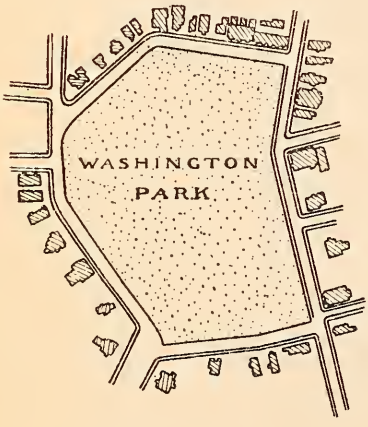
WELL ARRANGED STREETS
ON SHORE LINE



WINCHESTER

FIG. 20

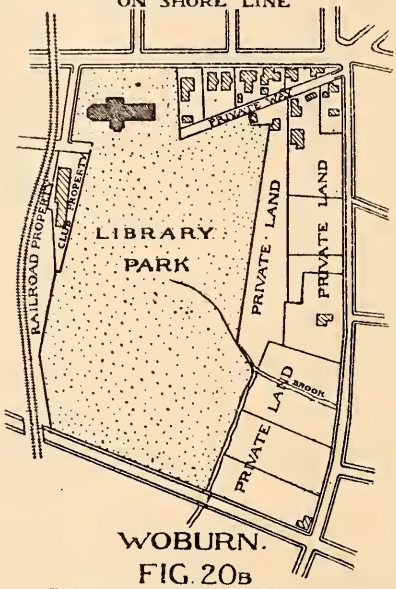
BADLY ARRANGED STREETS
ON SHORE LINE



ROXBURY

FIG. 20A

WELL ARRANGED
PARK BORDER ROAD



WOBURN.

FIG. 20B

BAD PARK BOUNDARIES.
LACKING BORDER ROADS

EXAMPLES OF STREET ARRANGEMENTS,
GOOD AND BAD.

gridiron pattern of our local streets, also tend favorably in some instances to deflect traffic from localities especially needed for residential use. Irregularities of this kind, no matter how picturesque, should not be allowed to remain, however, in localities which lie in the path of traffic or which are needed for important business use.

For lack of level ground, and to satisfy the modern popular demand for house sites upon commanding elevations, the private development of streets upon abrupt hills has assumed widespread proportions throughout the suburbs of Boston. These developments, familiarly known as land-development schemes, are usually undertaken by landowners hastily and at the smallest possible initial expense. As a consequence, a scheme of roads is usually adopted which requires the least amount of surveying to line it out upon the ground and the least amount of clerical work to describe the land in the deeds of conveyance. The scheme of road subdivision which is adopted in such cases is naturally the rigid gridiron. Although such a scheme may be laid out cheaply, and the lots sold and their streets then saddled upon the town, they are exceedingly expensive to the community in the long run, for the reason that their roads are too steep for convenient use or for economic maintenance. The series of plans opposite page 198 show the contours of the steep hill at Wollaston, in Quincy, and the gridiron which was laid out

situation has been prevented at the start by the provision of a border street paralleling the railway and the river respectively. (See figs. 17 and 19.) Property upon the margin of ponds and streams is safeguarded by border roads of this kind, since they allow houses to be built facing the water rather than backing upon it, and insure ready policing, to prevent disorderly misuse of the water frontage. Such roads are needed at the present time around Wedge Pond in Winchester, and should be provided in the course of time along the borders of all waterways of the district which are unprotected by parks or which are not to be reclaimed by filling or used for mercantile purposes.

Similar border roads are desirable upon the margins of parks, to secure for them frontages of houses facing upon the park rather than backing upon it, and at the same time to prevent trespass or disfigurement of the park. These border roads also prevent pleasure seekers from trespassing upon adjoining private grounds. (See figs. 20A and 20B.)

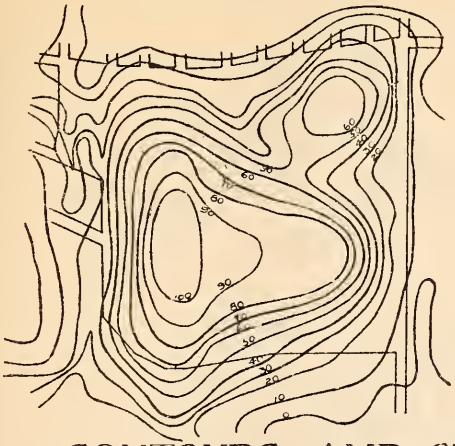
A number of local parks in the district are unprovided with border streets of this kind, and as a consequence dwellings are being erected adjoining them with their sides or backs turned toward the park. This situation exists in Woburn, Winthrop, South Braintree, and in many other places. In the metropolitan park system and in the city of Boston parks border roads have been provided in every instance as an organic part of the design of the park. Cemeteries are in need of the same sort of protection for the orderly development of property upon their borders. It may be said that the cemeteries of the district are largely unprovided with border streets, with the result that they are suffering seriously by the aspect of rear premises which are exposed towards them, and by rubbish which is cast into them over the fences of adjoining private property.

upon it. One need visit this gridiron but once to become fully aware of its exceedingly steep gradients; indeed, the visit should be made upon foot, for heavy carriages of light draft or automobiles of light power cannot climb the majority of the streets. Wollaston does not stand alone in this regard, for there is hardly a community in the district, with the exception of Dover, Weston, Westwood and Canton, which fails to possess examples of this type of street scheme. Fortunately there are in the district some hills which have been laid out with road schemes of a radically different kind. For example, upon the steep slopes of Aspinwall Hill, in Brookline, roads of gentle gradient have been built which, while providing for an intricate subdivision of the land into house lots, allow approach to the dwellings by vehicles of light power. Short-cut paths leading down the steep slopes of the hill are also provided, to afford direct communication with the lowland for persons on foot. (See plan opposite this page.) East Boston was built upon an ingenious plan, having a similar intention, but based upon straight instead of curving streets. Though this scheme fails to provide easy gradients for every street, it is in the main successful. Winthrop was also built upon a plan of convenient roads designed in a way to fit the contour of the ground conveniently.

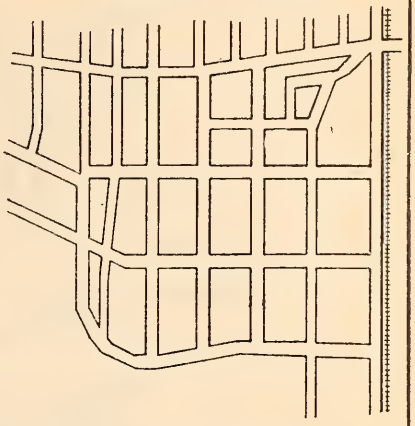
Road systems of this kind, which conserve the resources of hilly ground in spite of its topographical difficulties and render it valuable to the community as a whole, are an asset to the district. Those road systems of an opposite kind, which tend rather to fortify the hills as permanent obstacles in the traffic circulation of towns, become a perpetual source of inconvenience and expense to the community. This type of development should be checked by acquainting the public with its folly, by illustrating rational solutions with working plans, and by securing better laws for its control. The larger rights of the community should not be at the mercy of individual caprice.

In order to assure the extension of old streets which with new connections may afford useful through streets for the community, a similar effort should be made to control private subdivisions of land upon level ground. It should not be per-

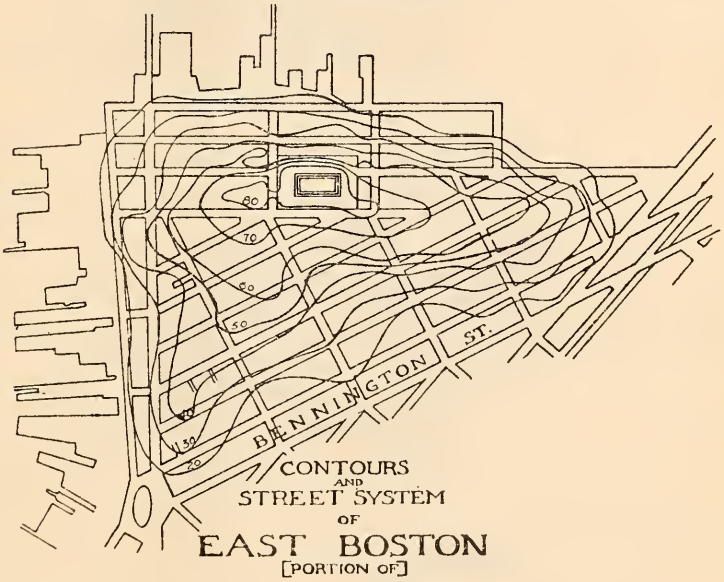
CONTOURS



STREET SYSTEM



CONTOURS AND STREET SYSTEM
OF
WOLLASTON



CONTOURS
AND
STREET SYSTEM
OF
EAST BOSTON
[PORTION OF]

CONTOURS

STREET SYSTEM

CONTOURS AND STREET SYSTEM
OF
ASPINWALL HILL BROOKLINE

FIG. 1

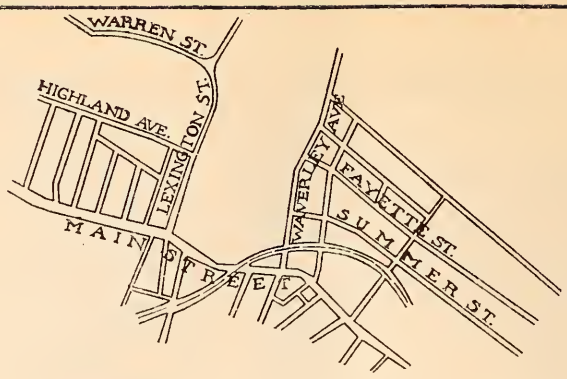


FIG. 2

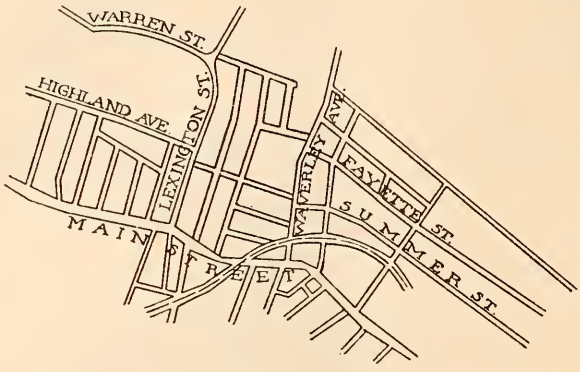


FIG. 3

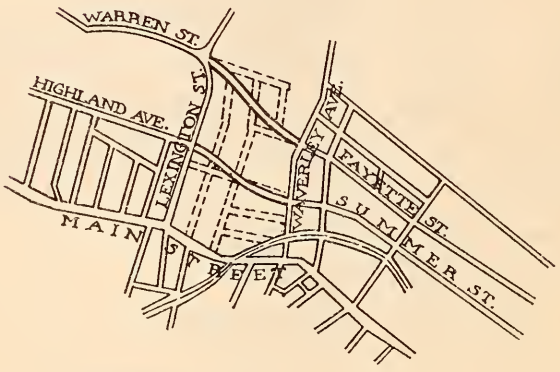
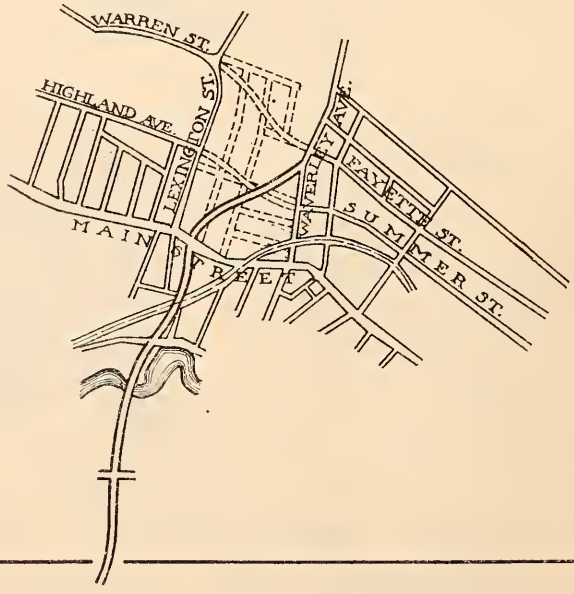


FIG. 4



A WATERTOWN EXAMPLE OF DEFECTIVE PLANNING; WITH SUGGESTED IMPROVEMENTS.

missible, for instance, for a private individual to fill in with an irrelevant system of streets an important open space in a town which needs for the convenience of the community a system of streets connected with those already built.

An example of this kind is illustrated in a series of diagrams opposite this page, which show a portion of the town of Watertown. Fig. 1 shows the vacant pasture land between Lexington Street and Waverley Avenue which interrupts the continuity of Summer Street, Highland Avenue, Fayette Street and Warren Street. A connection between these streets is essential to the proper longitudinal development of the town. Fig. 2 shows the street system with which the pasture has lately been laid out by its owner, in total disregard of the adjacent streets, but merely with consideration of the depth of the lots which are offered for sale. Fig. 3 shows the plan which the engineer of Watertown regards as essential to the interests of the town.

By a strange coincidence it happens that the latter plan, Fig. 3, while it is satisfactory for the street system of Watertown, fails to consider the interests of the district at large, inasmuch as an extension of Howard Street to Waverley Avenue is needed by improvements now pending to the south of the river in Newton, which have for their object a cross-district road to Belmont, Arlington and Medford. (See Fig. 4.) Similar examples, illustrating local land-development schemes in hostile relation with the streets of a town and with the thoroughfares of the district, are to be found in every community of the district, and represent a fearful waste of effort which might be saved by the existence of authorities and laws intended to safeguard the rights of the community against the whims or misfortunes of individuals.

The Width of Streets.

Measurements have been taken throughout the district of the width of local streets, and a summary of these measurements has been made which shows that a width of about 40 feet prevails. While such a width may be serviceable for streets of residential localities and for certain business districts, it is

wholly inadequate for thoroughfares which are to carry even a moderate traffic.[1]

Although the capacity of a street to carry traffic can be determined with accuracy, there is nevertheless a half-hearted belief, amounting to a superstition in the community, that certain streets have individual characteristics or dispensations which render comparisons of their widths with the widths of other streets largely inconclusive. For this reason it may be fruitless to point out that by far the greater proportion of the streets of the district are too narrow to accommodate traffic even of the lightest kind, — that is to say, the majority of the streets are not wider than Court Street,[2] Boston, at the Ames building (approximately 40 feet wide), which has been for years a bane to traffic because it will accommodate only three lines of vehicles. The wider streets of the district, as an average, are equivalent in width only to that portion of Devonshire Street between the Old State House and Adams Square (approximately 50 feet wide), — a street which will accommodate, only with serious crowding and with narrow sidewalks, four lines of vehicles, including a double track for electric cars.[3] The great streets of the district are exceedingly few in number, and are almost wholly comprised by the main radial thoroughfares, the several pleasure parkways and boulevards, and a few cross streets like Massachusetts Avenue and Southampton Street, Boston, and the Brook Road, Milton.

The conclusion is not to be drawn from this situation that wholesale widenings must be made throughout the district. It is to be concluded, rather, that those streets whose importance for traffic purposes is unquestioned should be made the subject of careful study. In a majority of cases it will be found that costly widening of built-up streets can be obviated by deflecting a part of their traffic into nearby streets whose widening and extension can be cheaply effected, or by building new streets

[1] The streets of Buffalo average from 66 to 99 feet in width. Minneapolis has few streets narrower than 60 feet, the majority being from 60 to 100 feet. The outlying streets of Chicago range from 66 to 100 feet in width.

[2] A section of Court Street is shown in Fig. 11, opposite page 202, with vehicles of 7 and 8 feet over-all width. See also a description of limiting widths on page 201.

[3] A section of this portion of Devonshire Street is shown in Fig. 12, opposite page 202, with vehicles of moderate and maximum width, together with electric car lines.

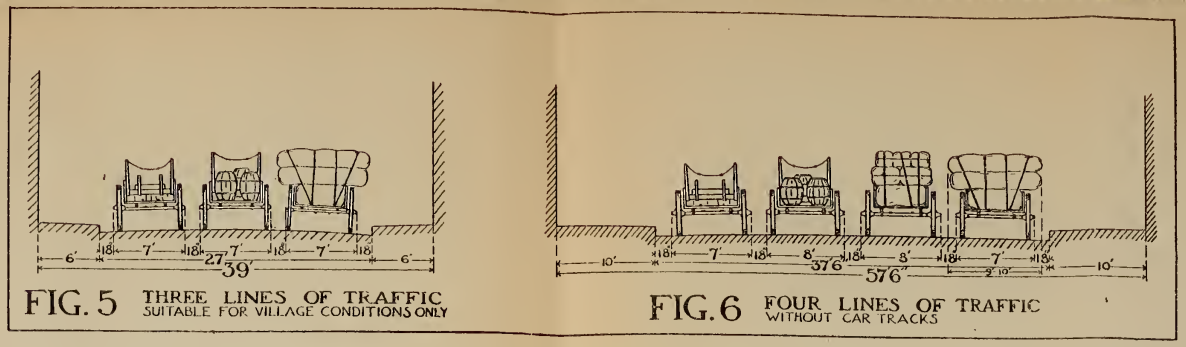


FIG. 5 THREE LINES OF TRAFFIC SUITABLE FOR VILLAGE CONDITIONS ONLY

FIG. 6 FOUR LINES OF TRAFFIC WITHOUT CAR TRACKS

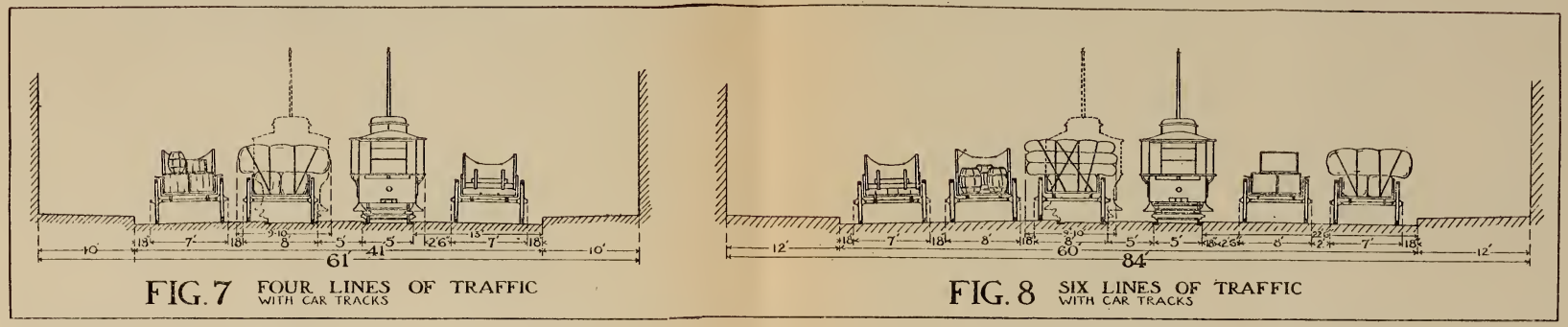


FIG. 7 FOUR LINES OF TRAFFIC WITH CAR TRACKS

FIG. 8 SIX LINES OF TRAFFIC WITH CAR TRACKS

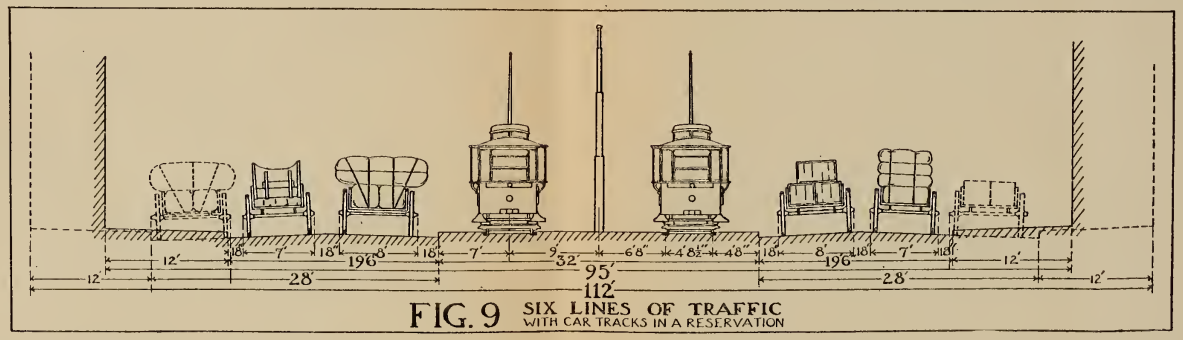


FIG. 9 SIX LINES OF TRAFFIC WITH CAR TRACKS IN A RESERVATION

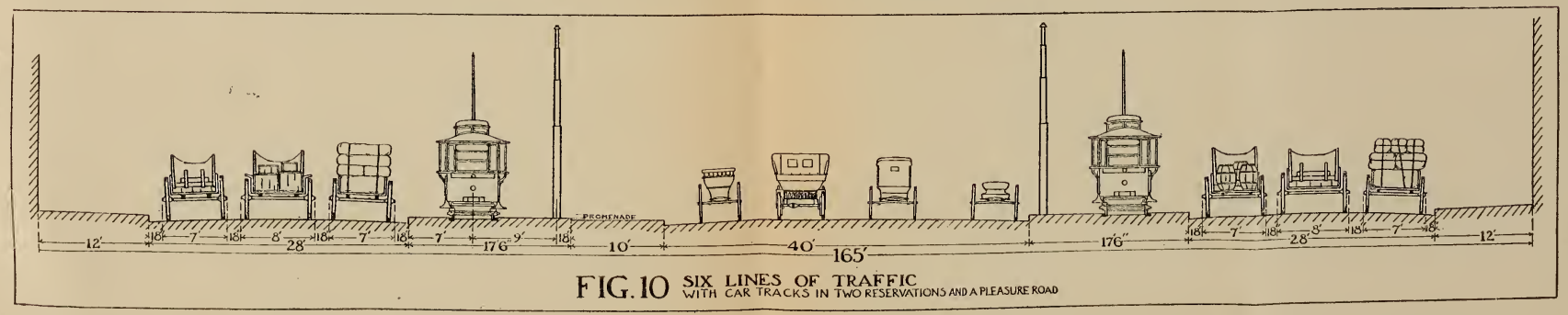


FIG. 10 SIX LINES OF TRAFFIC WITH CAR TRACKS IN TWO RESERVATIONS AND A PLEASURE ROAD

DIAGRAMS OF LEAST WIDTHS ALLOWABLE FOR TRAFFIC STREETS

in adjacent vacant land. Our cities and towns, and indeed a large portion of Boston, are still in a formative condition, and the time is therefore by no means past when improvements can be carried out in this manner at relatively small cost.

The more general factors governing the minimum width of streets may be briefly described as follows: —

A country street, upon which carriages pass infrequently, need not have great width; if sufficient space is provided for two vehicles of ordinary size to pass one another little remains to be desired. A street in a village, however, should have sufficient width to allow vehicles delivering goods or passengers to stand at each side of the traveled way while leaving sufficient gangway between them for a chance moving vehicle to pass, and it should also provide sidewalks for foot passers. Assuming each vehicle to have an over-all width of 7 feet (the width of an ordinary express wagon or milk cart), and to be allowed a leeway of 18 inches on each side, the total width of such a street with narrow sidewalks (6 feet wide) becomes 39 feet. (See Fig. 5, opposite page 200.) A street of this capacity would evidently be inadequate for an important street of a country town where vehicles are constantly passing in each direction, and where opportunity should be allowed for two vehicles, even of the widest kind, to pass freely between those standing at the side of the road. Moreover, the sidewalks should be wide enough to accommodate a greater number of foot passengers. Assuming half the vehicles to measure 7 feet over all in width, and the other half to measure 8 feet over all (the width of the widest drays), such a street becomes 57½ feet wide, with 8-foot sidewalks but without accommodation for electric cars.

Important side streets or the main street of a town should be made wide enough to accommodate two electric car tracks in addition to other traffic. Inasmuch as teamsters habitually fit the near wheels of wagons in the near rail of street car tracks, and as such rails are about 5 feet apart, the two inner lines of wagon wheels cannot conveniently approach nearer than this distance. Assuming four lines of wagons, one-half being 7 feet wide and the other half 8 feet wide, the curb width of such

a street becomes 41 feet, and the entire width, with 10-foot sidewalks, becomes 61 feet. (See Fig. 7, opposite page 200.)

It is evident that the presence of electric cars upon a street of this width presents great inconvenience to the inner lines of wagons, since they are constantly obliged to swing off to the curb line to give way to passing cars, which in their turn are subject to delays occasioned by the tardy movement of wagons. To relieve this difficulty it often becomes necessary to free the car lines of wagon traffic by providing more ample accommodations alongside. Assuming 7 and 8 foot wagons and 12-foot sidewalks, the curb widths of such a street become 60 feet and its total width 84 feet. (See Fig. 8.)

To insure a constantly clear right of way to the car tracks of such a thoroughfare, a special reservation is often provided by enclosing the car tracks with curbings, over which vehicles may not pass, making a street 95 feet wide. (See Fig. 9.) This arrangement divides the street in two and largely prevents erratic diagonal movements of vehicles. To permit freedom of movement in these divided ways, and to allow greater traffic capacity in highways of such importance, it is customary in most cities to provide room for three lines of vehicles on each side of the car reservation. (See Fig. 9, which illustrates a street of this type 112 feet wide.)

A street which is intended to carry a large amount of pleasure travel together with a considerable volume of traffic should have special accommodation made for this composite use. This is necessary no less for the convenience of traffic than for the comfort of pleasure vehicles. To allow light, rapidly moving vehicles to mingle with heavy, slow-moving traffic places a premium upon confusion and danger. Assuming four 7-foot vehicles upon a pleasure driveway between two car lines, and assuming two traffic streets for three lines of 7 and 8 foot vehicles each, together with two sidewalks of 12 feet each, the total width of such a thoroughfare becomes 165 feet. (See Fig. 10.)

The width of all modern streets in the Metropolitan District should be determined with regard to the number of lines of vehicles which they are to carry, the width of the vehicles

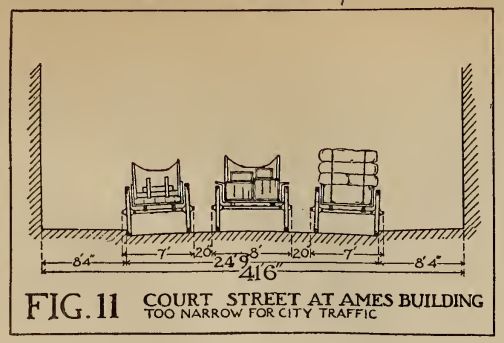


FIG. 11 COURT STREET AT AMES BUILDING
TOO NARROW FOR CITY TRAFFIC

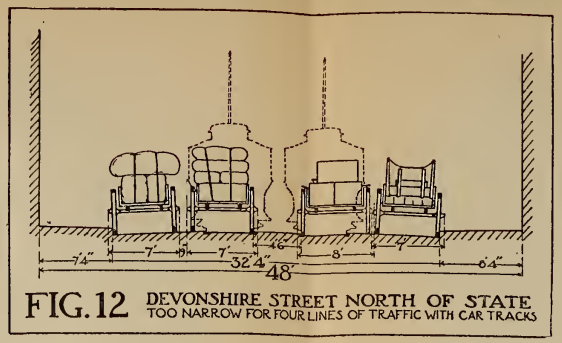


FIG. 12 DEVONSHIRE STREET NORTH OF STATE
TOO NARROW FOR FOUR LINES OF TRAFFIC WITH CAR TRACKS

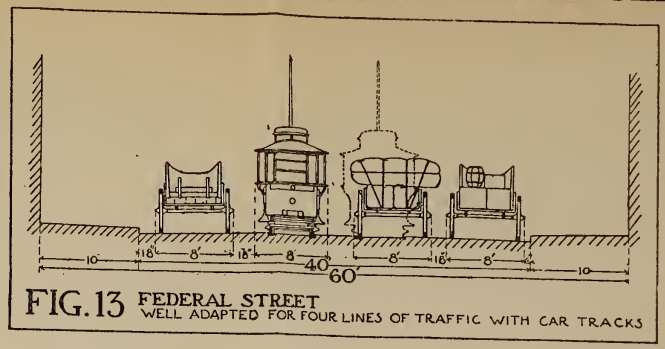


FIG. 13 FEDERAL STREET
WELL ADAPTED FOR FOUR LINES OF TRAFFIC WITH CAR TRACKS

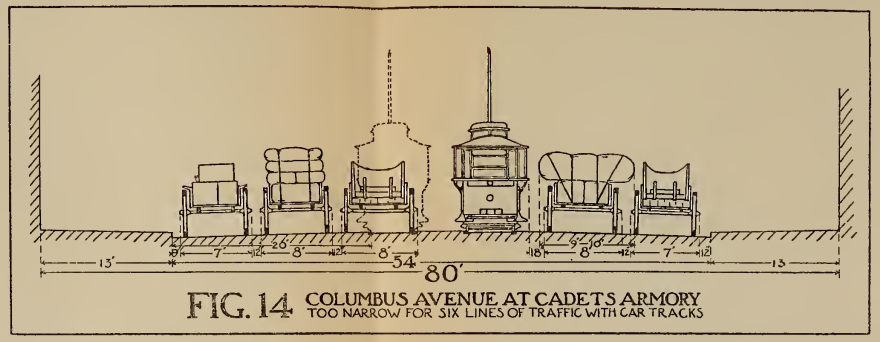


FIG. 14 COLUMBUS AVENUE AT CADETS ARMORY
TOO NARROW FOR SIX LINES OF TRAFFIC WITH CAR TRACKS

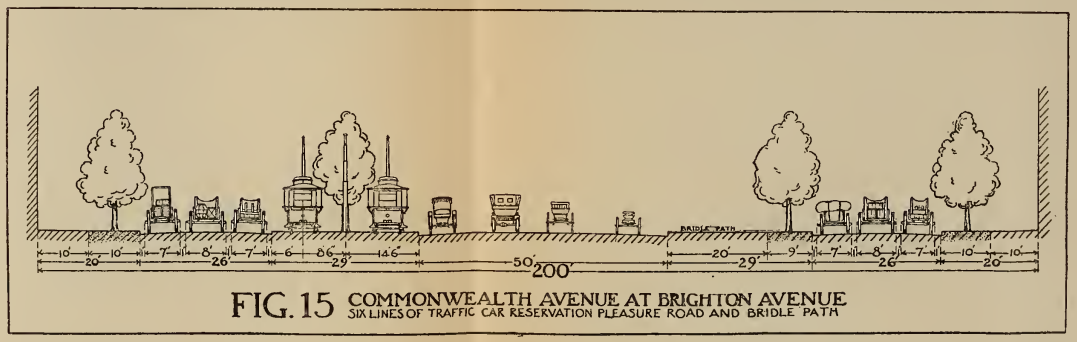


FIG. 15 COMMONWEALTH AVENUE AT BRIGHTON AVENUE
SIX LINES OF TRAFFIC CAR RESERVATION PLEASURE ROAD AND BRIDLE PATH

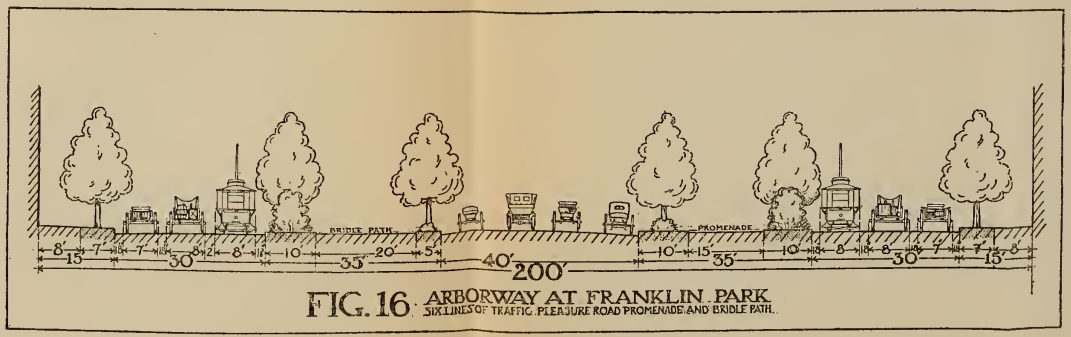


FIG. 16 ARBORWAY AT FRANKLIN PARK
SIX LINES OF TRAFFIC PLEASURE ROAD PROMENADE AND BRIDLE PATH

EXAMPLES OF EXISTING TRAFFIC STREET WIDTHS

themselves, a safe and convenient leeway between the vehicles, and with regard to ample sidewalk widths. The mere fact that our ancestors found 40 and 50 foot streets convenient for village and town use furnishes no reason for supposing that such traditional widths are suitable for modern city conditions, and for the use of modern drays, power vehicles, electric cars and for the crowds of foot passers which throng our sidewalks. The time has passed when any community in our district should permit a 40 or a 50 foot street to be laid out or perpetuated if it is to carry important traffic. Practice and not theory alone has established the folly of such narrow streets for such service, and has approved the wider 60-foot street, which at best provides only meagre sidewalk accommodations. A study of Devonshire Street, approximately 50 feet wide (Fig. 12), as contrasted with Federal Street, 60 feet wide (Fig. 13), should be made upon the ground to make the fact clear. Illustrations are given in figs. 14, 15 and 16 of other streets of greater width, some of which are well designed to accommodate their intended number of traffic lines without crowding, while others just miss, by a few feet, convenience and safety. While streets should be made as narrow as their requirements will permit in order to waste as little land as possible which might be devoted to building purposes, proper consideration should be given to their service as providers of light and air, as providers of shade by street trees, and as features of visual attractiveness.

The Gradient of Streets.

A decade ago, when the bicycle was generally used by a large proportion of the community, an appreciation of gradients was brought home to all of us. Until that time a knowledge of the significance of steep hills had been largely the special privilege of drivers of heavy wagons and drays. To-day the situation has undergone another change; bicycles have gone out of vogue and only a small proportion of the public is physically inconvenienced by bad gradients, while a large number of persons have learned to disregard them wholly by that new standard of strength, the high-powered automobile, — a vehicle which climbs hills in the same manner that it almost

annihilates distance. There is a danger, therefore, that the dependence of heavy horse-drawn vehicles and of power trucks of heavy burden upon easy gradients may be overlooked. To forget this need would be to neglect the first requirement of a road suitable for use by all classes of vehicles.

The need of providing gradients of the least possible steepness is made evident upon considering the rate at which the efficiency of draft horses decreases upon sloping ground. Upon a gravel street which rises 3 feet in a distance of 100 feet (forming a 3 per cent. gradient), a horse can pull only one-third the load which he could draw upon a level gravel street. If the steepness of the street be increased to a rise of 7 feet in 100 feet (a 7 per cent. gradient), the load drawn becomes only one-tenth of that possible upon level ground, while upon a gradient of 10 per cent. only one-fiftieth of the original burden can be moved. Similar laws limit the traction of motor vehicles. The astonishing drawbacks of hills having only a moderate slope have led most municipalities to require gentle gradients, even at great cost, for important bridges and for other works where the slope of roads is controllable. Upon the new Cambridge bridge and the new bridge to Charlestown an inclination of 3 per cent. was not exceeded in the approaches. Upon the approaches to the bridge over the Boston & Albany Railroad on Beacon Street, Boston, near the cross roads, the gradient is 2.8 per cent. At the Everett station, upon the main traffic thoroughfare between Charlestown and Everett, which was lately elevated to abolish a grade crossing, the gradient is 4.8 per cent.[1] This slope is too severe for such an important thoroughfare. The bridge recently built in extension of Atlantic Avenue, over the switch yard of the South Station, and intended to connect South Boston at Broadway with Dewey Square, has almost wholly failed in its usefulness on account of the gradients of 5 per cent., which are too severe for heavy traffic. Unfortunately this gradient is not excessive as compared with many of the steep hills which still beset our highways. Evidently it should be an object of any organized sys-

[1] See Everett, in Appendix.

tem of highway improvements to secure the easiest gradients possible.[1]

The positions of steep gradients occurring upon the existing radial and circumferential roads are shown by contours upon both of the large folded maps opposite page 256.

The Relation of Streets to Public Parks and Parkways.

Large parks, if they are to fulfill the purpose which justifies their cost, must of necessity interfere in some measure with the lines of streets. To allow traffic ways to cross them frequently, or to cross them at all where their landscapes require continuity, would be a waste of the public funds invested in the park. The parks of Boston and the Metropolitan District are designed to offer the least obstacle to local streets while maintaining adequate landscapes. Traffic roads, carefully designed to be hidden from the scenery of the park, cross many of them.

The majority of the greater parks and reservations are also provided with complete systems of border roads, the purpose of which is to connect, in a workmanlike manner, local streets which abut upon the park and which without a boundary road would terminate in dead ends. The border roads also simplify the control of trespasses and nuisances affecting private property as well as parks upon park boundaries. (See figs. 20A and 20B, opposite page 197.)

The parkways of Boston and of the Metropolitan District are designed, with few exceptions, to exclude traffic, inasmuch as their chief function is to allow pleasure vehicles to circulate to and from the parks without danger of annoyance by teaming. In some instances traffic roads are provided paralleling the parkway, as in the Arborway, while in other cases land has been secured for such traffic ways, though they have not been built, as in the instance of the westerly portion of the Revere Beach

[1] The following list of streets, familiarly known to persons in the vicinity of Boston, may be of interest in connection with their gradients for purposes of comparison: —

State Street, opposite Exchange building, 2 per cent.; Tremont Street at Hotel Touraine, 3.5 per cent.; Tremont Street, between Park and Winter streets, 4.2 per cent.; Atlantic Avenue bridge, 5 per cent.; Beacon Street, between Walnut and Spruce streets, 5.7 per cent.; Beacon Street, between Tremont Street and Boston City Club, 6.6 per cent.; Mount Vernon Street, between Charles Street and Louisburg Square, 10 per cent.

Parkway. Electric car reservations have also been provided in the majority of the metropolitan parkways.

Generally speaking, the provision for traffic in the parkways has been satisfactory, but there is a growing feeling that the pleasure ways of the future should provide better accommoc tion for traffic. Similarly, the greater traffic roads which are to be built should provide accommodation for pleasure vehicles. Such reciprocity of public service is needed in most metrop itan thoroughfares, especially in those which follow circumferential courses.

The parks and parkways of Boston and of the district are now controlled by commissions who maintain and extend the open spaces under their care upon the basis of plans which have been presented to the public in comprehensive reports, and which have received general approval. It is, therefore, unnecessary to discuss park improvements except in so far as they are mentioned in connection with the local street systems of the several cities and towns.

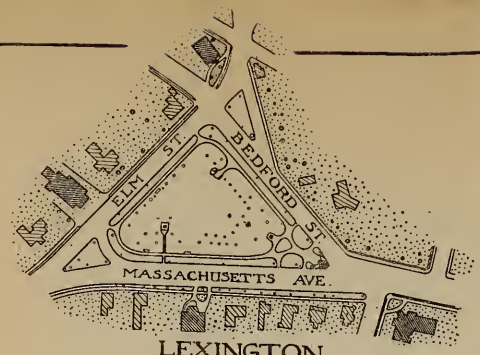
Squares at Traffic Centers.

Throughout the Metropolitan District at the junction of important thoroughfares a variety of open spaces occur which are generally known as squares. They are usually found in the older parts of the community where main roads fork in the shape of a Y or T, while they rarely occur where two main lines cross at right angles. (Note exceptions at Dedham, Fig. 25, and Medford, Fig. 34, opposite this page.) This fact readily explains their prevailing triangular shape, which originates from the rounding or short cutting of angles of the fork, to facilitate the movement of vehicles or foot passers, and to provide space for the accommodation of vehicles stopping at watering troughs or at stores.

In the majority of the suburbs the square has become a center in all senses of the word, and has been treated as a place of distinction, typifying the civic pride of the community. In it are found the finest mercantile buildings, churches and municipal offices, together with public monuments, flag poles and bandstands. These open spaces are *propylæa* and *fora,*

EAST SAUGUS
FRANKLIN SQUARE
FIG. 21

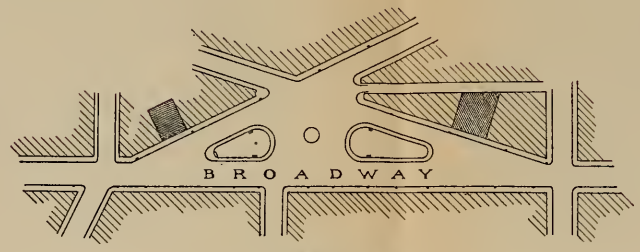
JAMAICA PLAIN
MONUMENT SQUARE
FIG. 22



LEXINGTON
FIG. 23

WOBURN
FIG. 24

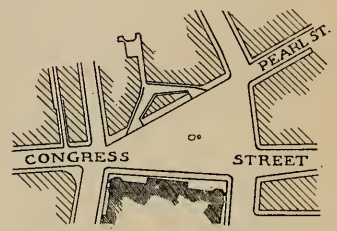
DEDHAM
FIG. 25



CHELSEA
WINNISIMMET SQUARE
FIG. 26

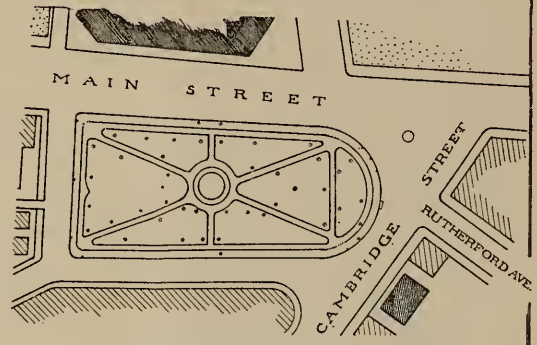
QUINCY
FIG. 27

HAYMARKET SQ.
BOSTON
FIG. 28



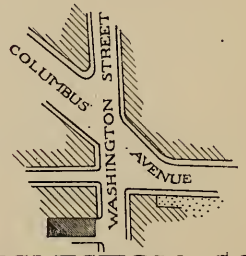
POST OFFICE SQ.
BOSTON
FIG. 29

HINGHAM CENTRE
FIG. 30



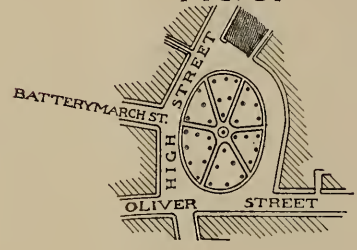
SULLIVAN SQUARE
BOSTON
FIG. 31

MAPLEWOOD SQ.
MALDEN
FIG. 32



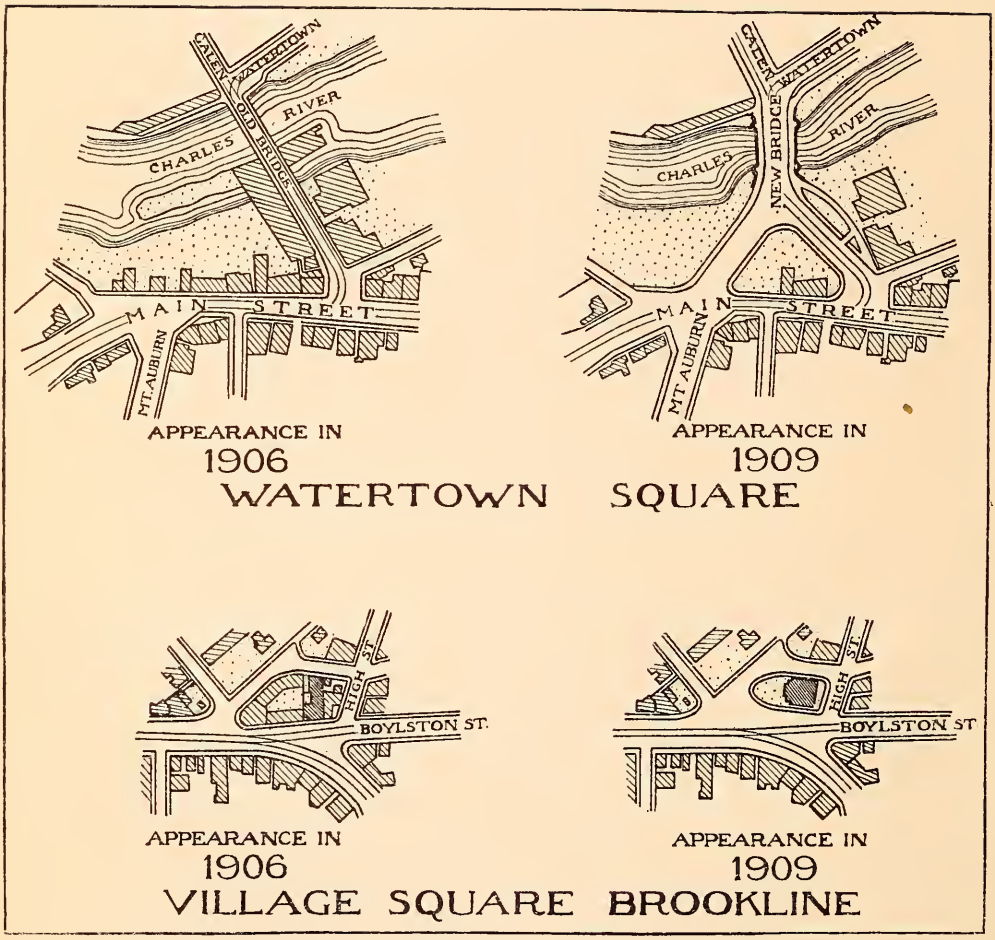
EGLESTON SQ.
ROXBURY
FIG. 33

MEDFORD
FIG. 34



FORT HILL SQ.
BOSTON
FIG. 35

TYPICAL MINOR OPEN SPACES IN METROPOLITAN COMMUNITIES.



ENLARGEMENTS LATELY MADE IN BROOKLINE AND WATERTOWN SQUARES.

and perform a service which cannot be transferred to that more general class of recreative open spaces, — the parks. In certain communities, including Woburn, Lexington and Quincy, the triangular squares were made unusually large in size for reasons of local convenience or taste, and have become noteworthy in the Commonwealth for their admirable appearance. (See figs. 23, 24 and 27.) The great square or common of Lynn should be included among such notable open spaces. In the district as a whole, however, squares were laid out upon a meager scale. (See figs. 21, 22 and 32.) They were designed for rustic communities, in which they were once a conspicuous center, but as these villages have grown to the proportion of cities and towns the squares have become too insignificant in relative size to perpetuate the old sentiments of distinction. It remains for such communities to decide whether they will allow the ancient sentiment and its visions to be wholly lost in this manner; they should decide whether they are satisfied merely to repaint their old liberty poles and replant the ivy around their soldiers' monuments, rather than to enlarge the square itself to a size commensurate with the regard in which the citizens esteem their own history and the individuality of their community. (See plan opposite this page.)

Malden Square is little better than a slightly widened street. The same is true of the squares of East Saugus, Melrose, West Medford, Medford (see Fig. 34), Everett, Newton, West Newton, Braintree, Weymouth, Hingham and many other towns, including Liberty Square, Egleston Square (see Fig. 33) and other squares of Boston.

Copley Square, Boston, and Winnisimmet Square, Chelsea (Fig. 26), are interesting composites of the triangular and rectangular squares. In Copley Square this strong diagonal line has always been difficult to reconcile with schemes for a symmetrical treatment of the floor of the square.

It should not be supposed that the presence of a square at a meeting point of traffic roads necessarily prevents or even relieves traffic congestion at that junction. On the contrary, it may contribute to congestion by allowing several merging

lines of vehicles to lose their continuity and to become snarled in a manner impossible in narrower channels. For example, the traffic difficulties of Haymarket Square (Fig. 28) are intensified not alone by the great number of streets which lead directly into that open space, but by the field which is offered there for the erratic movement of vehicles. In Sullivan Square, Charlestown (Fig. 31), on the contrary, the presence of a large central reserved plot prevents such disorganized use of the open space while contributing to its safety for pedestrians and to its good appearance. The great triangle (occupied in part by a church) in Quincy Square, Quincy (Fig. 27), tends in the same manner to maintain unbroken the lines of traffic while passing through the square. An open space still better designed to prevent traffic disturbance is illustrated in the square of Hingham Center (Fig. 30), which enjoys no considerable traffic at the present day but is well designed for traffic contingencies. This plan shows the side streets through which vehicles may pass to the most favorable side of the square before entering it, and by means of which diagonal crossings through the midst of the square may be almost wholly avoided. By-pass streets of this character, intended to classify traffic before it enters an open space, or to permit a portion of the traffic to go around the center of congestion, should be incorporated in the design of future open spaces of this character. A design intended to solve traffic problems at a square in this manner is admirably shown in the proposed junction of the Fellsway with the Revere Beach Parkway (Fig. 38). The diagram illustrates the separation of traffic from pleasure vehicles, and shows an attempt to retain the decorative advantages of the characteristic "Round Point" while divesting it of its usual serious traffic complications.

The days of square-building are by no means past. Watertown has just created a new center of this kind, and the enlargements of Village Square, Brookline, and the improvements at Belmont may be named in the same class. (See plan opposite page 207.) To allow two great thoroughfares to meet or to cross one another without providing an enlargement at the junction to accent the importance of a focal point would be to commit a structural mistake, and to miss an opportunity for

desirable variety in the usual monotony of streets. Should the metropolitan community construct in the future the much-needed circumferential thoroughfares, a number of squares ought to be created where these new ways cross the radial thoroughfares. These points of traffic confluence should be made at once convenient for use of vehicles and shapely for the satisfaction of the eye. Posterity should then be able, by the buildings which it might erect upon the margins of these open spaces and by the monuments and decorations which it might provide for its islands of safety and division, to render these squares fitting expressions of the forethought of a past and a taste of the new generation.

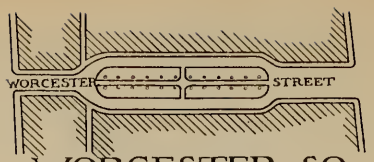
Long after the triangular squares of the traffic centers were built many rectangular squares were created throughout the district in residential localities largely for decorative purposes and to afford recreative opportunities. Since they formed integral parts of land-development plans, laid out with gridirons of streets, their form naturally became rectangular. This characteristic gives them an orderly appearance, and makes them an intimate part of their architectural surroundings.

Among these open spaces may be mentioned Louisburg (Fig. 36), Worcester (Fig. 37), Franklin and Blackstone squares in Boston, together with Hastings and Broadway squares in Cambridge, and Longwood Square in Brookline. A great variety of other open spaces of this character are sprinkled through the suburbs. Fort Hill Square (Fig. 35), though it possesses a degree of symmetry, is not to be included among these squares which were consciously created for visual effect, but which lack the peculiar charm and individuality of this remarkable open space. Fortunately we have in our midst a sufficient number of the picturesque squares of early times to permit us to develop more geometric forms without running a risk of mannerism. Squares of this symmetrical type prevail in many parts of our country as well as in Europe. Soldiers Place and Niagara Square in Buffalo (figs. 41 and 42) belong to this type. Audubon Circle, Boston (Fig. 40), and the circle (whose central plot was lately removed as a hindrance to traffic) at the junction of Canton Avenue and the Blue Hills Parkway of the Boston metropolitan park system (Fig. 39) are similar in design. Squares of

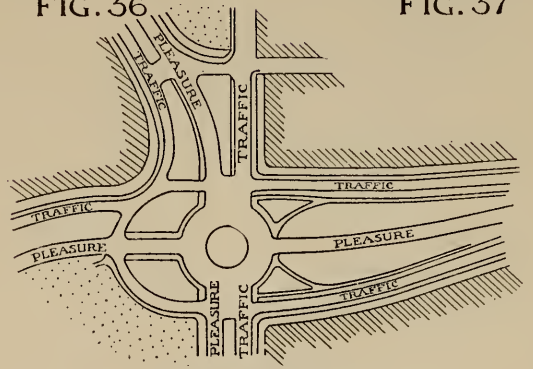
this circular form are becoming so numerous both in this country and in South America as well as in Europe that there is likely to be a changed feeling with regard to the constant repetition of a figure so commonplace and so productive of traffic congestion.

A review of open spaces at the junction of important thoroughfares cannot be dismissed without mentioning the relation of public buildings to such squares. (See the heavily shaded buildings in figs. 21 to 49, inclusive, opposite page 206 and this page.) Since the earliest times it has been customary to place churches and town buildings upon the borders of the town squares, but of late this custom has received a new impetus. To secure desirable architectural effects and to permit convenient administration, a general movement has been inaugurated all over the district to gather libraries, schools, city halls and other public and semipublic buildings into groups. The appearance of these compositions depends, of course, upon the success with which the new buildings have been placed in relation to old ones and upon the adaptability of the ground to use for building sites. (See the South Braintree group, Fig. 42, and the Melrose group, Fig. 43.) Few towns have prepared at the outset a careful group plan by which the position of future buildings can be known, and by following which an agreeable appearance and a structural convenience may be assured. It is too often the custom to regard each structure as an independent problem, and merely to place it near another building in the blind hope that a succession of such enterprises may produce an arrangement at once pleasing to the eye and adapted to convenient use. (See the squalid school group of the North End of Boston, opposite page 217.) The success of the various town groups is hardly to be judged at present since they are in a formative state. The Chelsea school group (Fig. 49) belongs to a class of methodically placed structures, and the Brookline group (Fig. 45) tends in that direction. The Cambridge, Winchester and Meeting House Hill (Fig. 44) groups have a certain mass effect and possess great picturesque quality, although they are not symmetrically arranged. Where concentrated effort has been directed to-

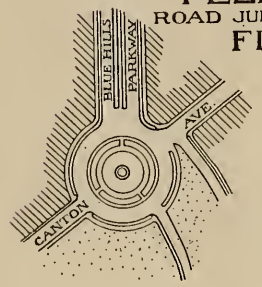
LOUISBURG SQ.
BOSTON
FIG. 36



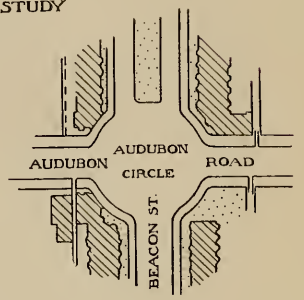
WORCESTER SQ.
BOSTON
FIG. 37



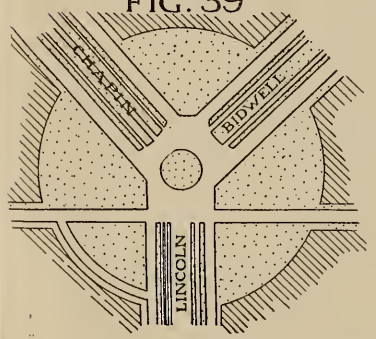
FELLSWAY
ROAD JUNCTION STUDY
FIG. 38



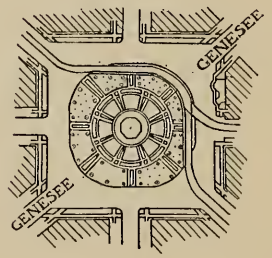
BLUE HILLS
PARKWAY
FIG. 39



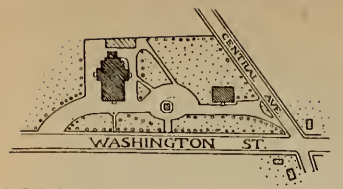
AUDUBON
CIRCLE
FIG. 40



SOLDIERS PLACE
BUFFALO
FIG. 41A

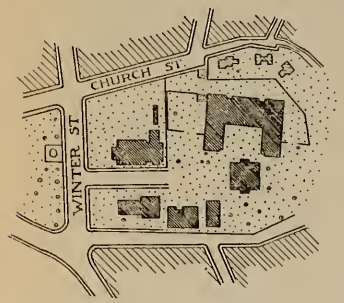


NIAGARA SQ.
BUFFALO
FIG. 41B

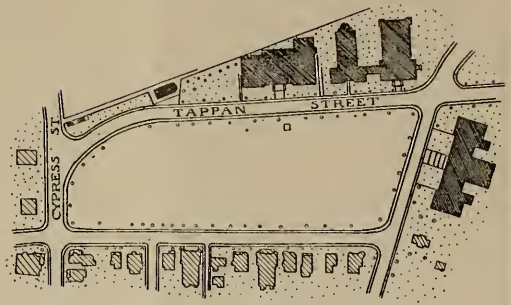


SOUTH BRAINTREE
FIG. 42

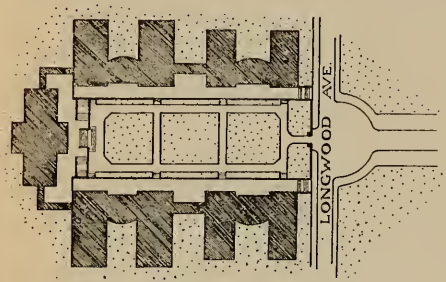
MELROSE
FIG. 43



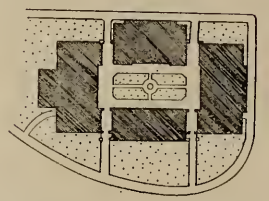
MEETING HOUSE HILL
DORCHESTER
FIG. 44



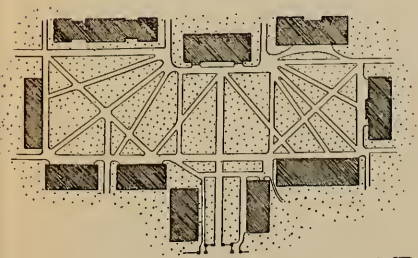
BROOKLINE
PLAYGROUND
FIG. 45



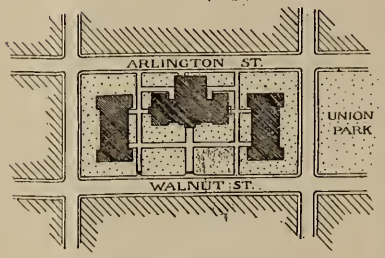
HARVARD MEDICAL
SCHOOL
FIG. 46



NORMAL AND LATIN
SCHOOLS
BOSTON
FIG. 47



HARVARD COLLEGE YARD
CAMBRIDGE
FIG. 48



CHELSEA
WILLIAMS SCHOOL GROUP
FIG. 49

SQUARES IN RESIDENTIAL SECTIONS.

ward the realization of one definite group, either for a short period of time with ample funds at hand, or for a long period during which the object in view has never been lost to sight in spite of small means, we should expect to find groups of buildings of a more orderly placement. Consider, for example, the excellent quadrangle of Harvard College (Fig. 48), which required over a hundred years for its completion, and the admirable medical school group (Fig. 46), which was built in two years. Fig. 47 illustrates a public school group executed by a commission in a period of about the same length for the city of Boston. It will be seen that the success of such groups depends not so much upon the cost of the buildings or the promptness with which they were erected, as upon the adherence to a definite scheme of composition by which buildings of a similar style were assembled closely enough to one another and with sufficient unification of approaches and exposures to give an effect of common service.

Conclusions.

The radial thoroughfares of the Metropolitan District are with few exceptions well distributed, direct, wide and of gentle gradient. In passing through most of the cities and towns, however, these great roads are in danger of serious traffic congestion, because in such localities they are constricted in width and are not paralleled by other roads through which local and through traffic may also be carried.

The circumferential thoroughfares of the district are, with few exceptions, narrow, crooked and broken in their alignment. This unfitness embarrasses cross-town and cross-district circulation and tends to throw undue burdens of traffic upon the radial thoroughfares, especially in the vicinity of Boston proper. With the extraordinary development of motor vehicle traffic these defects are becoming serious.

The local streets of the cities and towns of the district are not developing in a manner to relieve the radial thoroughfares of local traffic or to create new cross-town and cross-district highways; upon the contrary, they are developing in a fashion to hasten congestion and to hinder town to town circulation.

The direction of the existing highway lines coincides with the direction of the needed lines of highway extension, and the openness of the district as well as the inexpensive character of the few buildings which stand in the way of these extensions also contribute to ready solutions of the problem. Unfortunately, however, the town, city, county and metropolitan authorities in control of the highways of the district are unable to take these problems in hand, either because the field of their jurisdiction is too local, or because the special acts of Legislature under which they were appointed do not apply to such problems.[1]

Inasmuch as a large portion of the district is now seriously handicapped by these conditions, new authority should be created for the execution of certain of these highway improvements of unquestioned need. The board in whom this authority may be vested should also familiarize itself with the entire highway situation of the district. It should safeguard the interests of the community by keeping the public informed of the progress of street development, by offering advice to towns and individuals, by publishing plans of needed improvements and by active execution of such plans when necessary.

The activities of such a board should not abridge the authority of local boards or of town and city engineers, but should render possible a co-ordination of their individual efforts for the common good. By such co-operation it should be possible for each city and town to carry out its own local street improvements in a way to further the development of the street systems of adjoining communities, and thereby conserve the resources of the entire district. It should also become the duty of such a board to codify and strengthen the laws relating to the control of highway extensions. At present there is little check upon the rights of individual landowners to saddle upon cities and towns streets which tend to block rather than to extend existing public highways.

At present the district does not need and cannot afford improvements intended to appeal directly to the eye by their magnificence, and designed to win popular approval by novelty

[1] See the powers of these authorities, on page 257.

rather than by convenience or necessity. The varied topography of our seaboard, river valleys and hill country, together with the individuality of our local street systems, require no additional novelties to recommend them. Our immediate task is to co-ordinate these varied street systems by discovering and perfecting the most useful connections which can be made between them. In this work we should not be blind, however, to the appearance of these new thoroughfares. They should be shapely as well as direct, and should appeal no less to the eye on account of their agreeable line, orderly junctions and pleasing terminations, than to the constructive senses on account of their admirable width, easy gradient and workmanlike surface.

In closing this report I wish to acknowledge my indebtedness for information and counsel to your honorable Board, to the committee on improvements of the Boston Society of Architects, to Mr. Frederick Law Olmsted, Jr., to Mr. Frank O. Whitney, engineer of the Boston Street Commissioners, and to the several engineers of the cities and towns who have assisted me with maps and statements of needed improvements. To my assistants, Messrs. R. W. Aldrich, R. P. Bellows and H. E. Millard, I am also greatly indebted for their painstaking services.

The following appended notes upon the street systems of the several cities and towns of the district are respectfully submitted with this report.

APPENDIX.

Note.—In the course of making the field study of the existing main highways of the district, a large amount of information of a local kind, bearing upon the chief thoroughfares, was collected which could not be embodied with sufficient detail in the foregoing report. This material is, therefore, presented separately in the form of an appendix and discusses the individual problems of each city and town of the district, summarized under the names of the several municipalities alphabetically arranged.

These notes do not attempt to cover all the aspects of local highway improvement, however, but only those more obvious needs which would become evident at first sight to any student of the main thoroughfares of the district when studying the relationship of these main roads to the local streets of the individual communities. The fragmentary character of the notes is frankly acknowledged. In an examination covering so large a field in so brief a time greater detail was impossible.

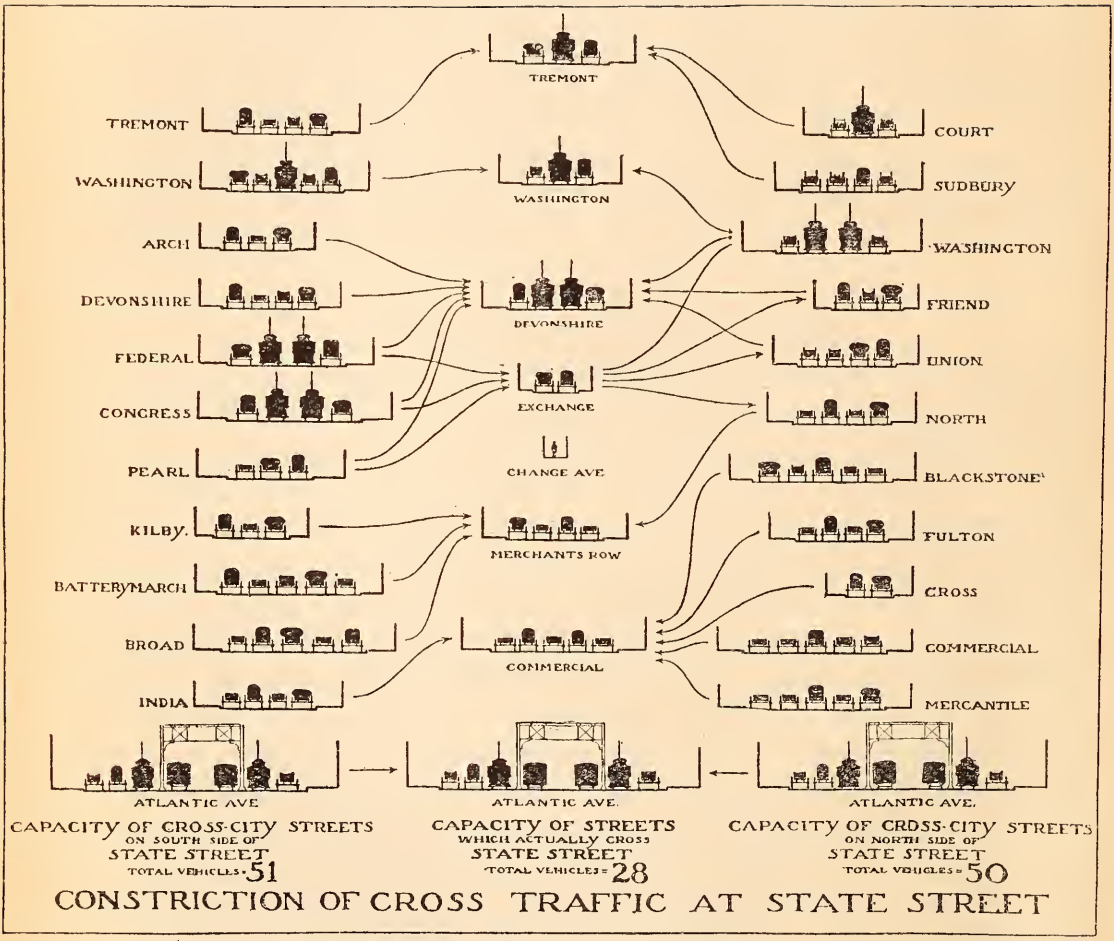
These notes cannot be understood without reading the main report, pages 187 to 213, and especially those parts of it relating to width and gradient, described on pages 199 to 204. Matters treated at length in the report are not mentioned in these notes except with the greatest brevity.

ARLINGTON.

See note above; also maps opposite page 256.

The street system of Arlington belongs to that general type illustrated upon page 196. The only through street of the town is Massachusetts Avenue, which serves local purposes besides connecting Concord, Bedford and Lexington with Boston. For reasons already described at length, towns having this primitive street system should take measures to develop as through roads the series of crooked and dead-ended streets which parallel the main road. Arlington should extend and widen Summer Street as a continuation of Lowell Street, past the almshouse along the north side of the railroad. The eastern end of Summer Street should be connected by a more direct route with Chestnut and Warren streets and thus form a main trunk road through the town. So abrupt is the ground upon the southern side of Massachusetts Avenue that a through street cannot be developed there. To form a convenient cross-district line from West Medford to Belmont and Arlington, River Street should be connected with Lake Street and the latter through Hill Street with Huron Avenue. Mystic and Pleasant streets should also be improved as important cross-district thoroughfares.

Among street improvements of a more local importance may be mentioned the following: extend Devereaux Street along the borders of Spy Pond to connect with Lombard Terrace at one extremity and with Pleasant Street at the other. Without a system of protecting border streets (see plans opposite page 197) Spy Pond property cannot develop conveniently or in a way to avoid unsightly misuse of its shores. A new protective street is also needed from Chestnut Street along the


TREMONT
WASHINGTON
ARCH
DEVONSHIRE
FEDERAL
CONGRESS
PEARL
KILBY
BATTERYMARCH
BROAD
INDIA
TREMONT
WASHINGTON
DEVONSHIRE
EXCHANGE
CHANGE AVE
MERCHANTS ROW
COMMERCIAL
COURT
SUDBURY
WASHINGTON
FRIEND
UNION
NORTH
BLACKSTONE
FULTON
CROSS
COMMERCIAL
MERCANTILE
ATLANTIC AVE
ATLANTIC AVE.
ATLANTIC AVE.
CAPACITY OF CROSS-CITY STREETS ON SOUTH SIDE OF STATE STREET TOTAL VEHICLES = 51
CAPACITY OF STREETS WHICH ACTUALLY CROSS STATE STREET TOTAL VEHICLES = 28
CAPACITY OF CROSS-CITY STREETS ON NORTH SIDE OF STATE STREET TOTAL VEHICLES = 50
CONSTRICTION OF CROSS TRAFFIC AT STATE STREET

westerly borders of the Mt. Pleasant Cemetery and following the line of Sucker Brook to Orient Avenue. In the future development of the streets of Arlington and Arlington Heights, the town authorities should attempt to control the private subdivision of land by streets of excessive steepness. This undesirable class of public ways has gained a foothold in the town and should be held in check. (See discussion of this subject on page 198.)

Belmont.

See note on page 214; also maps opposite page 256.

Waverley Street should be extended to Belmont, following the brook valley near the tracks of the Fitchburg division, to provide a more convenient connection for vehicles approaching Waverley via Concord Avenue, Belmont.

Pleasant Street should have a more direct connection with Waverley by means of a short branch road through the coal yard near the more eastern railway crossing.

A border road is needed along the easterly side of the lower half of the Beaver Brook Reservation, near the brook, to allow a convenient and sightly development of adjoining private property to take place. Without such a street buildings will shortly be erected with their backs rather than their fronts abutting upon this boundary line of the reservation. (See plans opposite page 197.)

Boston Proper and Back Bay.

See note on page 214; also maps opposite pages 216 and 256.

The number of street improvements which have been recommended for Boston in the past has been so great, and the number which have been executed is so small, that to suggest other improvements at this late day would seem to be fruitless. Nevertheless, many of the old problems still need solutions. The lapse of time during which they have been under consideration has served to establish their importance, although the cost of executing them has correspondingly increased. For example, the need of widening Exchange Street still presents itself, and the need of better communication between the North station and the Cambridge bridge still exists. Dozens of solutions have been offered for these problems, of which the more promising are described below.

Exchange Street (24 feet wide) forms an important crosstown line, since it is the natural extension of Federal and Congress streets. In spite of its great narrowness this street carries an enormous amount of traffic with great efficiency. Unfortunately, it is inadequate to accommodate the volume of travel which would naturally seek it. That more ample traffic roads are needed in this vicinity there can be no doubt. The traffic diagram opposite this page illustrates the capacities of the streets which converge upon State Street and the relatively meager

capacities of the streets which actually cross it. No improvement has been seriously considered which would relieve this situation to a degree comparable with the widening of Exchange Street. This costly improvement is a necessity. Its accomplishment would probably lead eventually to the widening of Union Street and to a better connection between Union and Endicott streets, but these contingencies need not be considered until the widened Exchange Street renders the needs of such consequential improvements absolutely certain.

The new Cambridge bridge should have a more roomy and a more sightly approach arranged for it at the junction of Charles and Cambridge streets. Without more ample space it cannot perform its traffic duties efficiently, and the attractiveness of the bridge structure cannot appear other than incongruous in relation to so ill-related and squalid an approach. The undesirability of the present arrangement will be still further aggravated when the elevated railroad structure is erected. Evidently a square is needed, with proper islands of safety to allow traffic to be distributed. A symmetrical square like that shown on the plan opposite page 218 would accomplish this purpose handsomely and well, though it would involve the destruction of many buildings. An open space of this kind would form a lead toward the realization of a direct street to the North station, following the line of Parkman and Fruit streets, Seabury Place and Eaton Street. The proposed street becomes very wide opposite the Massachusetts General Hospital grounds, owing to the narrowness of the block between Fruit and Parkman streets, and provision is, therefore, made for an island of planting, to separate the road from those grounds, and to afford a by-pass adjacent to it for the special use of the hospital. A 3 per cent. gradient is secured on the line of Eaton Street, at the cost of grade changes west of Chambers Street and upon a portion of North Russell Street. The profile of Chambers Street is not disturbed, however. It will be seen that this new route to the North station would also afford connection between the new bridge and Bowdoin Square, via Green Street, upon better gradients than those of Cambridge Street, and would obviate, therefore, the necessity of carrying out the long-contemplated widening of Cambridge Street. Green Street would then become a main thoroughfare requiring widening. Court Street requires widening in any case.

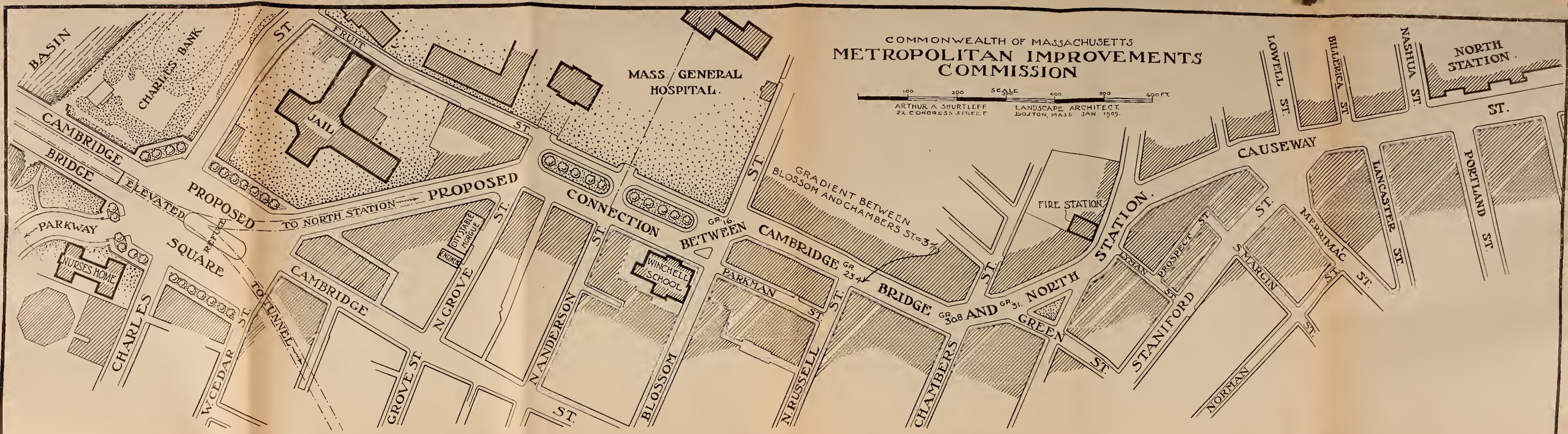
The large open space forming Post Office Square is not arranged in a way to assist foot passers to cross it, or to guide the vehicle traffic which skirts its margins. It is treated as a mere enlargement of the traffic streets, and serves as a shabby baiting ground for horses and a congregating place for idle drays and express wagons. (See plan opposite page 217.) The comfort of foot passers and the proper appearance of the square require that its center should be reclaimed from the streets and treated as a large island of safety, upon which

COMMONWEALTH OF MASSACHUSETTS

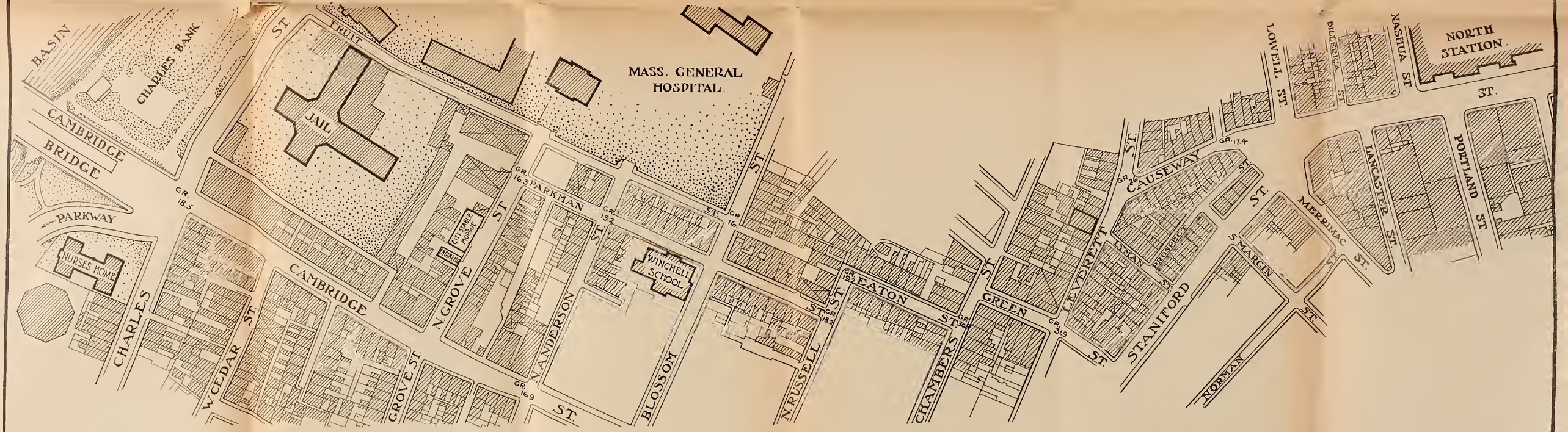
METROPOLITAN IMPROVEMENTS COMMISSION

SCALE 100 200 300 400 500 600 FT.

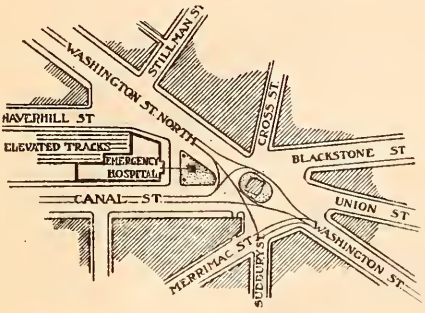
ARTHUR A. SHURTLEFF, LANDSCAPE ARCHITECT, 24 CONGRESS STREET, BOSTON, MASS. JAN 1909.



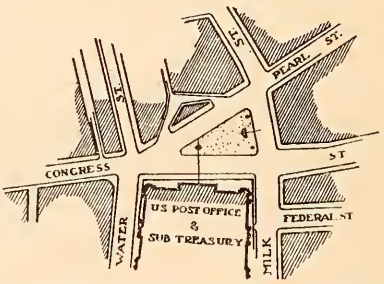
PROPOSED CONNECTION BETWEEN CAMBRIDGE BRIDGE AND NORTH STATION



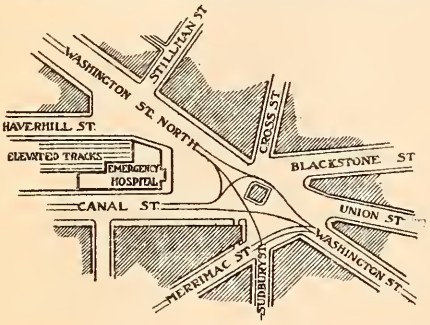
EXISTING STREETS BETWEEN CAMBRIDGE BRIDGE AND NORTH STATION



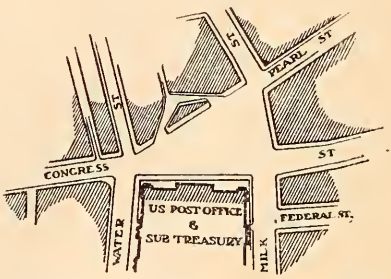
PROPOSED CHANGES HAYMARKET SQUARE



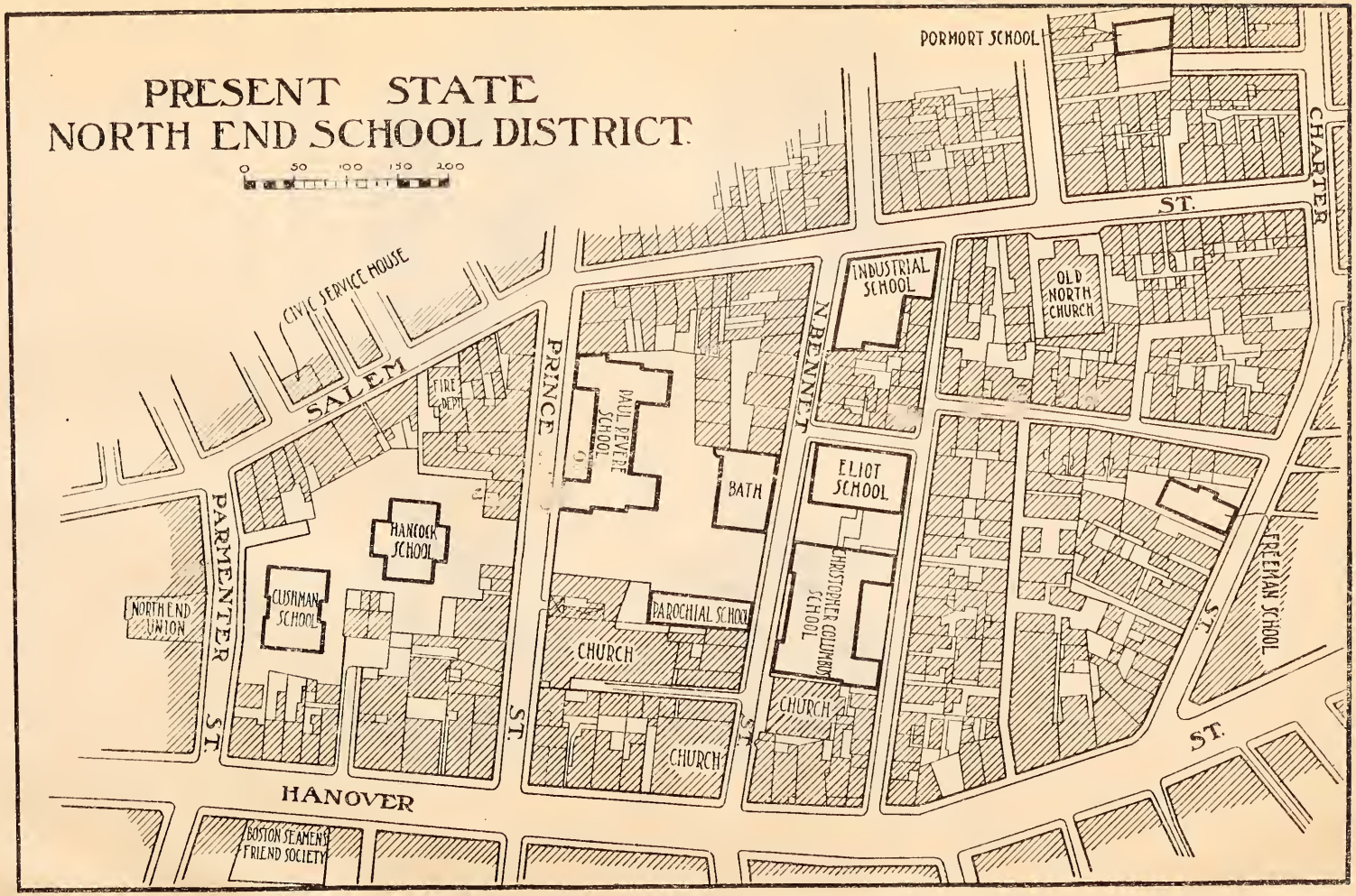
PROPOSED CHANGES POSTOFFICE SQUARE



PRESENT STATE HAYMARKET SQUARE



PRESENT STATE POST OFFICE SQUARE


PRESENT STATE
NORTH END SCHOOL DISTRICT
0 50 100 150 200
PORMORT SCHOOL
CHARTER ST.
CIVIC SERVICE HOUSE
SALEM
FIRE DEPT.
PRINCE
PAUL REVERE SCHOOL
N. BENNET
INDUSTRIAL SCHOOL
OLD NORTH CHURCH
BATH
ELIOT SCHOOL
HANCOCK SCHOOL
CUSHMAN SCHOOL
NORTH END UNION
PARMENTER ST.
PAROCHIAL SCHOOL
CHRISTOPHER COLUMBUS SCHOOL
CHURCH
CHURCH
CHURCH
ST.
ST.
ST.
FREEMAN SCHOOL
HANOVER
BOSTON SEAMEN'S FRIEND SOCIETY

convenient sidewalks, light standards, kiosks and drinking fountains might be arranged.

Haymarket Square (see plan opposite this page) should be similarly provided with islands for the safety of foot passers, and to assist in handling the diverse streams of traffic which cross it.

A diagonal short cut should be provided underneath the projected elevated structure from Lowell Street to the new Charles River dam. (See plan opposite page 218.) At present the Lowell Street to Cambridge Street traffic follows a circuitous course through Brighton Street, which furnishes a wholly inadequate portal for so important a line of communication with Cambridge. The diagonal which the elevated road is to cut offers an opportunity for the city to secure a direct connection of ample width.

The North End schoolhouse group and its vicinity is shown opposite this page. These schoolhouses are so closely huddled together and are so badly shadowed by adjoining private buildings that they require artificial light in many of their class rooms even in bright days. A single visit to this locality and to the schools themselves should convince any one that these conditions, if not actually criminal, are so bad as to deserve immediate remedy. Boston cannot regard itself as an enlightened city while it allows the children of the North End to be schooled in such shameful darkness and without proper playground space. This site should either be abandoned for school purposes, or a project for its reorganization should be made to enable it to fulfill its functions properly. If the site is to be retained, a certain amount of money should be set apart each year for the reorganization. Buildings which hem it in too closely should be torn down, and future school structures should be so placed as to form in connection with these new open spaces a comprehensive architectural scheme, providing proper light and air for each class room and sufficient playground space for the requirements of recreation. Of what economy is it to the community to maintain schools under conditions like those at the North End, which injure the eyesight of pupils and place a premium upon feeble bodies, and which tend to render the children to that degree incapable of profiting fully from the education which the schools provide?

The vicinity of the Providence Railroad property is shown opposite page 218, together with a convenient system of subdividing streets for the vacant land. The extension of St. James Avenue should relieve Boylston Street of some of its congestion, and form, with Eliot Street, an important link between the South station and Copley Square. Arlington Street is also shown extended to Ferdinand Street and the latter is shown widened. (See plan opposite page 218.) Clarendon Street is shown extended from the Back Bay station to St. James Avenue, in order to connect the new system of streets intimately with the nearest railroad station. This connection might be made more intimate

by a diagonal road (shown in dotted lines on the plan) leading from the station to Berkeley Street. The adaptation of a portion of this tract for occupation by a group of public buildings is shown in the figures opposite page 264, and is described briefly on that page.

The street system in the vicinity of the Back Bay Fens needs some modification to adjust it to the recent development of property and new roads. Montfort Street should be extended to Jersey Street and the latter across the Fens to provide in connection with Ruggles Street a new line of road connecting Cottage Farms and the cross roads with the vicinity of the Art Museum and with Roxbury. Audubon Road should be made a cross-town line by proper connections with the Cottage Farms bridge on the one hand and with Ruggles Street (see "Roxbury") on the other. The streets contemplated for the vicinity of Louis Pasteur Avenue should be reorganized to cross that new thoroughfare in a way to connect directly with Short Street and Huntington Avenue, as shown on the map opposite page 216. Short Street in Brookline may well be connected with Carleton Street by a bridge within the next half century, and form an important thoroughfare. (See "Brookline.")

The extension of Malden Street, to form with the Dartmouth Street bridge an important cross-town line, is discussed briefly on page 247. The gradients of Dartmouth Street at the Back Bay station should be eased, whether the street is extended or not.

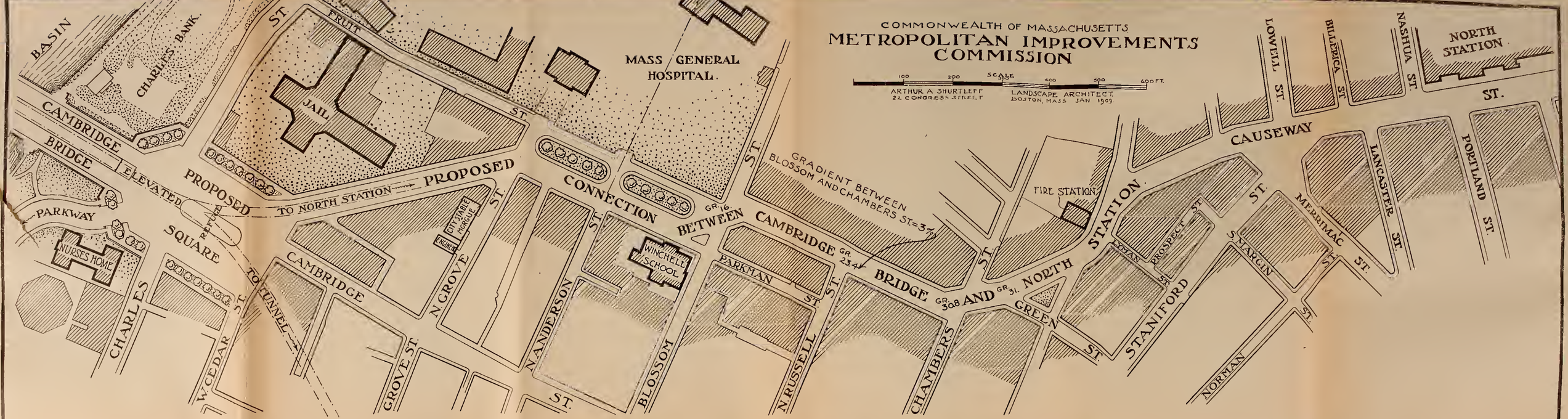
In the course of time additional bridge connections will be needed between Boston and Cambridge, to relieve the growing congestion of Boylston Street and Massachusetts Avenue and to afford more direct communication across the basin between the widely separated Harvard and new Cambridge bridges. Undoubtedly, however, the community will be willing to endure for a long time congestion and faulty lines of communication rather than to expend the great sums of money which would be required for bridges to span the great width of the basin. To reduce the cost of such thoroughfares Boston and Cambridge should carefully consider the feasibility of substituting earth causeways for portions of the bridge structures. A third to a half the cost of a continuous bridge between the present embankment lines might be saved by such earthworks. Inasmuch as the presence of additional bridges across the basin will radically change its appearance in any case, by subdividing it into a series of smaller basins, the possibility of using earth causeways planted with trees, to enhance the appearance and usefulness of these several basins, is also to be considered. The quadrilateral interspaces between the long bridges might be redeemed from monotony in this manner and their margins devoted to fuller recreative use by taking advantage of embankments intended to reduce the cost of the bridging operations. Earth causeways of this kind, if used as peninsulas to shorten the actual water space to be spanned, would place the bridges in mid-stream and produce a series of Binnen Alster basins,

COMMONWEALTH OF MASSACHUSETTS

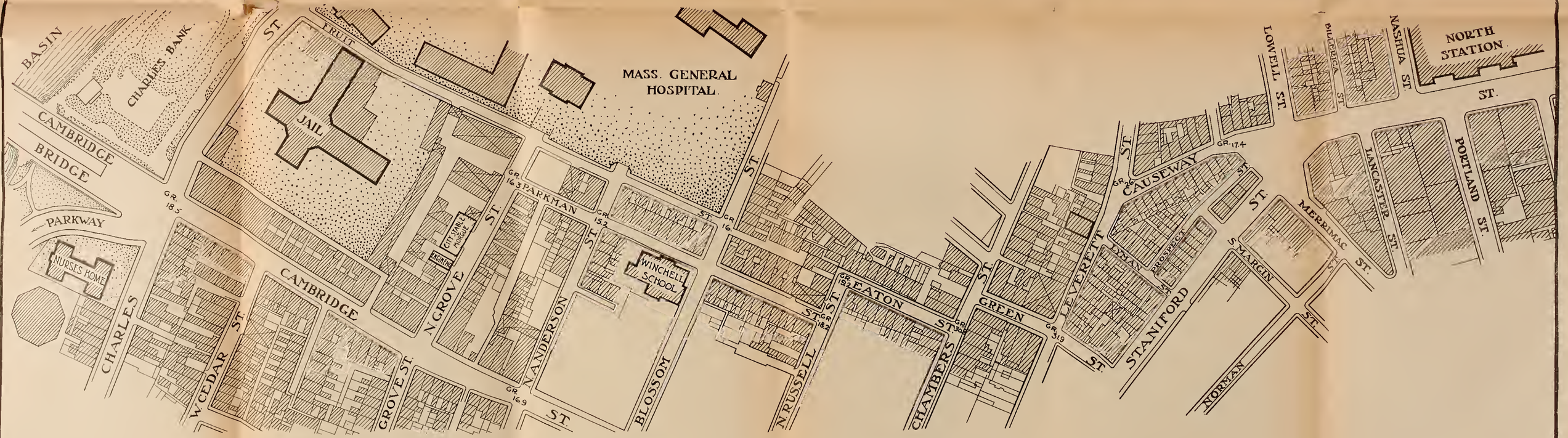
METROPOLITAN IMPROVEMENTS COMMISSION

SCALE 100 200 300 400 500 600 FT.

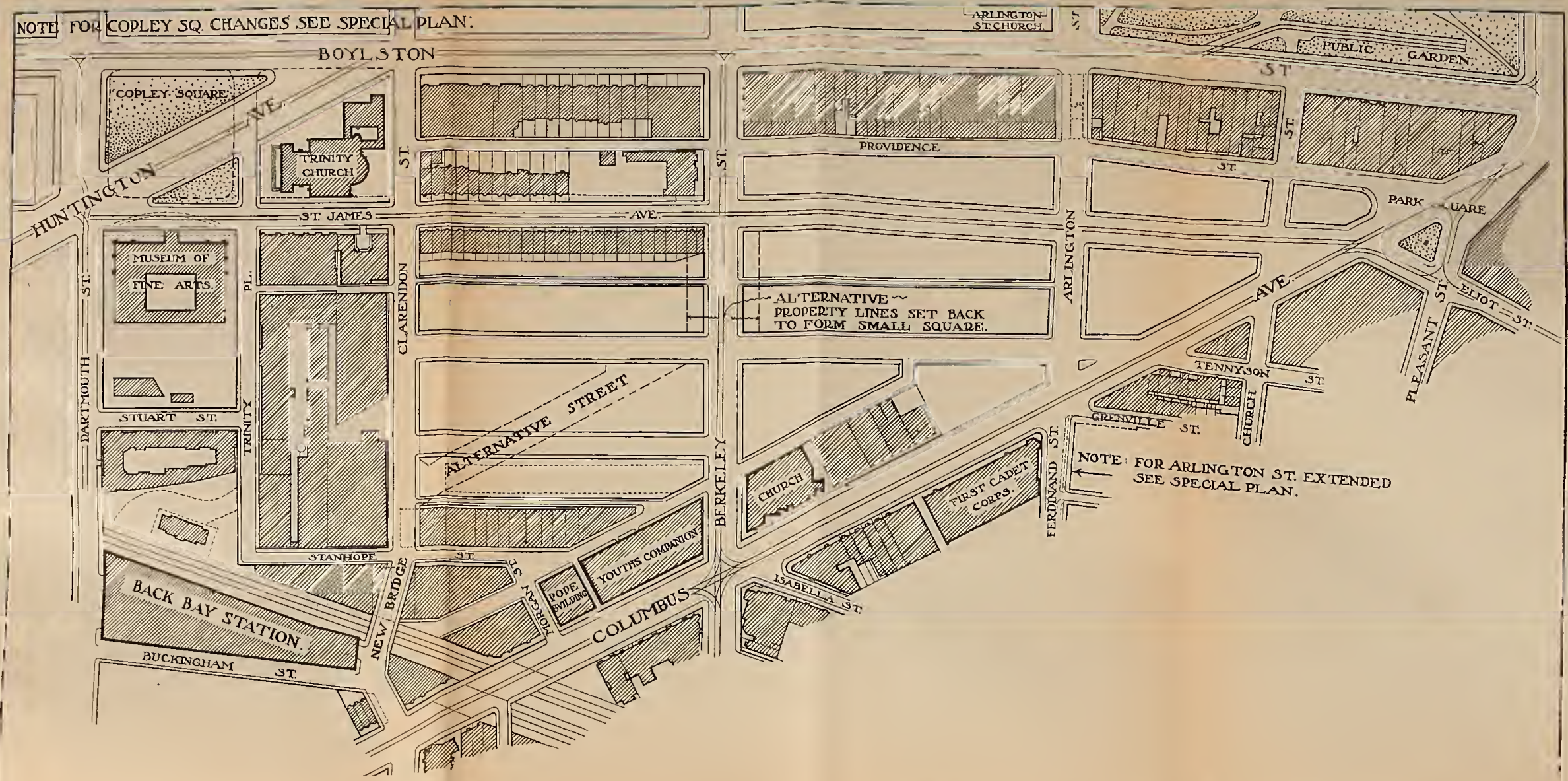
ARTHUR A. SHURTLEFF, LANDSCAPE ARCHITECT
24 CONGRESS STREET, BOSTON, MASS. JAN 1909



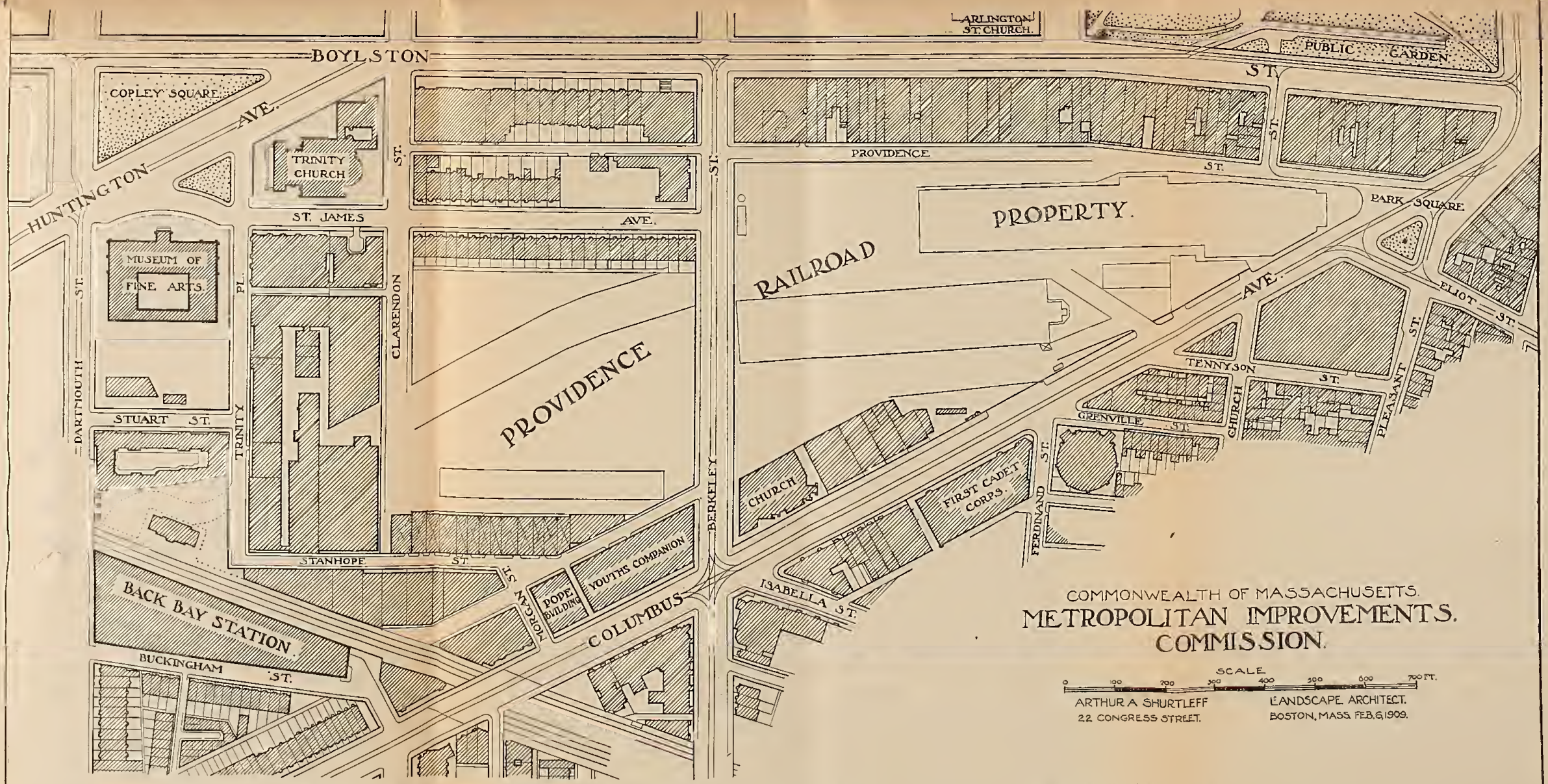
PROPOSED CONNECTION BETWEEN CAMBRIDGE BRIDGE AND NORTH STATION



EXISTING STREETS BETWEEN CAMBRIDGE BRIDGE AND NORTH STATION



PROPOSED SUBDIVISION BY STREETS PROVIDENCE R.R. PROPERTY



PRESENT STATE PROVIDENCE R.R. PROPERTY.

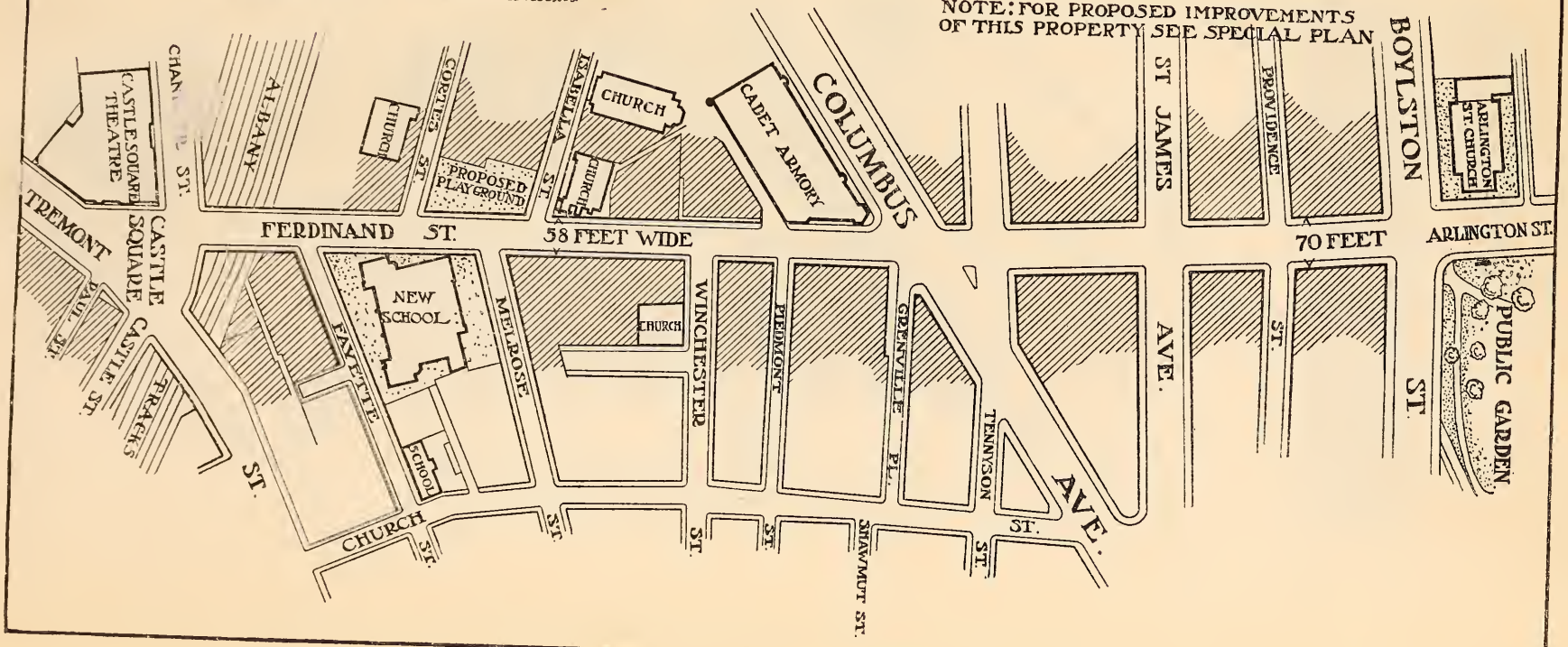
PROPOSED EXTENSION ARLINGTON ST. TO CASTLE SQUARE.

COMMONWEALTH OF MASSACHUSETTS.
METROPOLITAN IMPROVEMENTS COMMISSION.

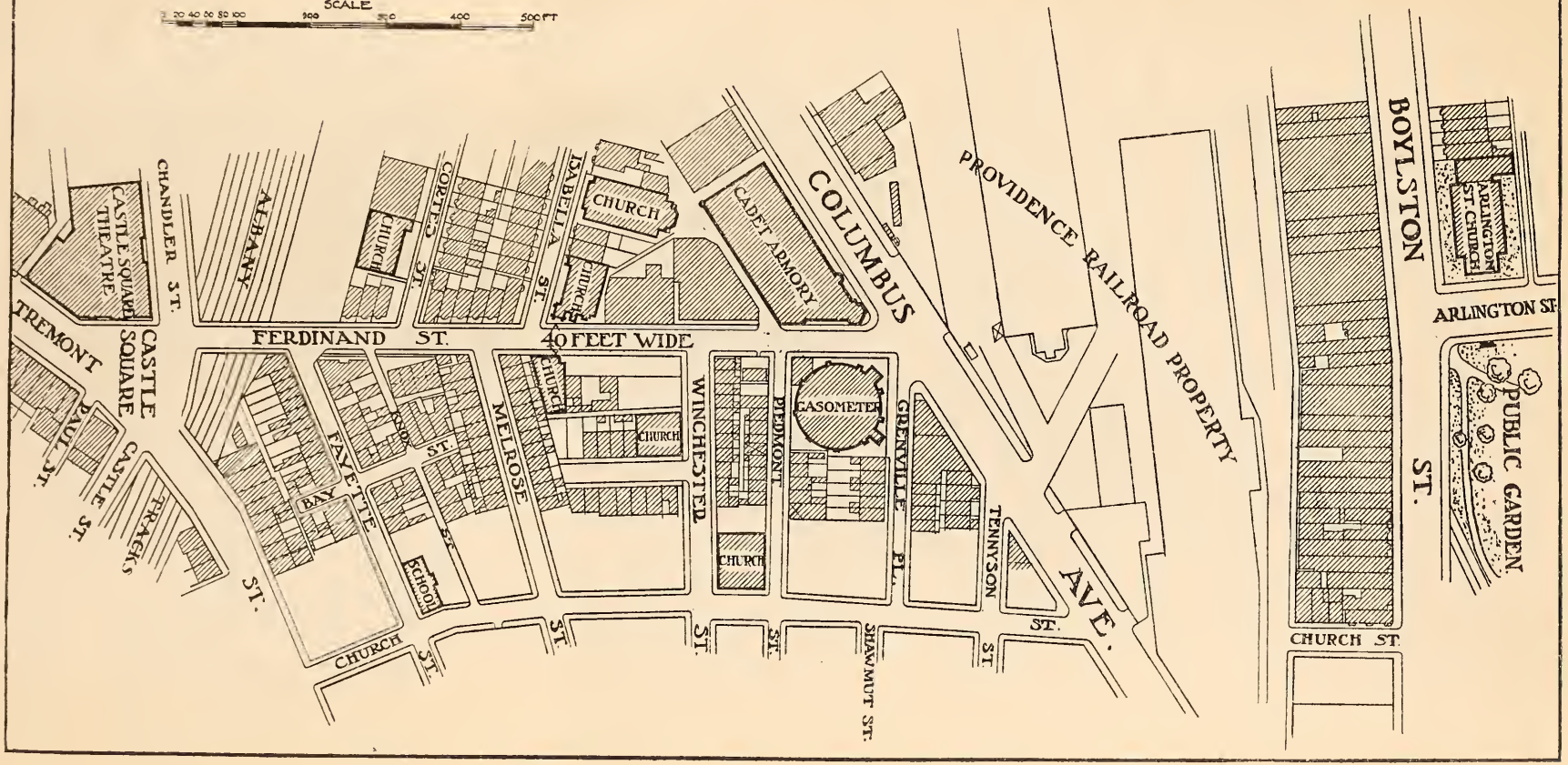
SCALE. 20 40 60 80 100 200 300 400

ARTHUR A. SHURTLEFF
22 CONGRESS STREET

LANDSCAPE ARCHITECT.
BOSTON MASS. FEB 6 1909.



EXISTING STREETS BETWEEN BOYLSTON ST. & CASTLE SQUARE.



while if these causeways were placed in mid-stream like islands, and connected with the Boston and Cambridge shores by short bridges, an effect would be produced like that to be seen in the rivers which contain the Isle de la Cité, Paris, the Island of Rousseau, Geneva, or the Kohlen-Inseln of Munich, but upon a larger scale. If these mid-stream islands were connected with one another to form one island of greater length, its recreative service would be immensely increased, and the appearance of the basin would be controlled largely by it rather than by the bridge structures and their approaches. This disposition of the earthworks would leave the present margins of the basin uninterrupted and would not interfere with convenient along-shore passenger boat traffic or pleasure boating, although the headroom under the bridges could not be so great as with the peninsula treatment. On the other hand, the peninsulas would interrupt the continuity of the present embankments and force pleasure and passenger boating into the mid-stream of the basin. The service of tree-planted earthworks of either kind, to check the winds of the basin and to make its use for skating and boating more popular and at the same time to render it more human in scale, would be important.

Such causeways or islands probably could be used to economize the projected replacement of the Harvard bridge while enhancing the usefulness and appearance of the basin. In any case they should be considered thoroughly in their wider application to the future bridge problems of this water sheet. To consider them as projects for reclaiming from the basin land which might be used for building purposes or for parks is largely futile at present, since the great amount of vacant land in the neighborhood of the basin and the ample provision already made upon its borders for recreation preclude the necessity of such works for many years.

Braintree.

See note on page 214; also maps opposite page 256.

The general distribution of roads in this town is good, but as a whole the highways are too narrow. Adams Street is only 35 to 45 feet wide, and yet it is an important connecting link. Pond, Commercial and Washington streets are too narrow. Franklin Street, which leads to the Five Corners, should be widened in advance of the development of this new center, and an open space or square should be reserved at this important junction. Braintree and East Braintree are deficient in an open space of proper size or character to form a town square. (See illustrations, figs. 21 to 49, opposite pages 206 and 210.) The group of public buildings at South Braintree is shown in Fig. 42.

A new cross-district road from Braintree to Hyde Park and Norwood via Monatiquot Brook and Houghton's Pond should be provided in the future.

Brookline.

See note on page 214; also maps opposite page 256.

The more unsettled portion of the town of Brookline lies between two great radial lines, — the Boston parkway, leading to the Arboretum, and Boylston Street, leading to Newton Highlands. At present there is no demand for a middle line of road between these two radial lines. In the future, however, roads will be needed in this tract to render it available for building operations and to provide convenient roads for local circulation. The main cross roads or circumferential lines also avoid this tract, with the one exception of Perkins Street and its continuations. This street needs improvement in line and gradient in the future, but at present it serves well enough. This improvement and others needed in the future are shown in part upon the map opposite page 216, and may be briefly described as follows: —

A short cut of a few hundred or a thousand feet is needed at the junction of Grove and Newton streets.

Clyde Street should be straightened and connected upon better lines and gradients with Lee Street, via Dudley Street.

A new street on easy gradients is needed immediately west of Chestnut Hill Avenue, in the valley, to provide a better line of connection between Beacon Street and Boylston Street (at Clyde Street). This new street, when connected through Lee Street with Clyde Street (the latter extended toward West Roxbury), should make, in conjunction with its connections through Brighton, Watertown and Belmont upon the north, one of the great thoroughfares of the district.

Reservoir Lane and Pound Lane need development into ample streets to allow cross-district travel, which passes through Lake Street, Brighton, and the reservoir, to continue southward to Clyde Street.

The Lake Street (Brighton) travel which crosses the Chestnut Hill reservoir and park property and enters Middlesex Road should be provided with a better entrance into Hammond Street. The present junction is abrupt and roundabout.

The improvements needed in the street system of the more densely settled portions of Brookline may be described as follows: —

Cypress Street should be extended to Harvard Street at its junction with Harvard Avenue. The present School Street connection between Coolidge Corner and Cypress Street is roundabout and is interrupted with undesirable gradients.

The relation of the street system of Brookline to the Cottage Farm bridge may be satisfactory as regards the convenience of Brookline, but it is not satisfactory as measured by the convenience of cross-district travel. To vehicles proceeding northward across the district over the Longwood bridge the zigzag course through Carlton and Ivy streets is bewildering if not dangerous. A street is much needed from the corner of Essex and Ivy streets to Beacon Street at its junction with

Carlton Street. If at some future day a bridge should be built across Muddy River from Carlton Street to Short Street this diagonal would become a link of still greater importance. (See map opposite page 216.) Freeman Street should be extended to Carlton Street.

Audubon Road should also be extended, with ample width and with easy curves, through Montfort and Essex streets to the Cottage Farm bridge. This improvement is of the greatest importance to the circulation between Cambridge and Boston of traffic entering or leaving Boston by way of Ruggles Street, and the Fens.

The proposed Magazine Street bridge to Cambridge, which would communicate directly with Pleasant Street, would require a new diagonal street in order to make good connections with the Longwood bridge through Powell Street.

Village Square, the chief center of Brookline, has lately been enlarged from its former cramped dimensions to a size which will always make it a notable square (see figs. opposite page 207 for its former and present condition).

Brookline's admirable street system upon the forbidding slopes of Aspinwall Hill are an object lesson to the community. (See plan opposite page 198.) Her system of ample local playgrounds, parks, schools and baths also furnish models to the district.

Cambridge.

See note on page 214; also maps opposite pages 216 and 256.

The street system of Cambridge, like that of Somerville, is laid out upon a plan very different from the primitive type which characterizes most of the cities and towns of the district. (See plan of typical town opposite page 196.) Cambridge has a highly organized system of streets which tends to distribute traffic upon many rather than upon a few highways and which allows circulation in all directions. The marginal streets of the city knit intimately with the streets of Somerville upon the north; but upon the south, communication with Boston, Brookline and Brighton is effected only by seven bridges, which cross the 5½ miles of wetted boundary of Cambridge upon the Charles. A new bridge from Kendall Square, Cambridgeport, to Copley Square, would tend to develop East Cambridge, and would relieve the heavy Cambridge traffic of outer Boylston Street, Boston, and of the Harvard bridge. A bridge on the line of Magazine Street would also render important service. A connection by bridge is now needed between Cambridge and Allston, west of Soldiers Field, to afford a through line of communication across the district from Brookline to Medford. The plan opposite page 222 shows the relation of this line to the existing streets of Allston, Cambridge and Somerville.

A through line still more urgently needed is indicated on the plan opposite page 194. It provides a northern outlet from Harvard bridge directly to Wellington bridge, and is intended to connect the

northern and southern halves of the district in a way to relieve present traffic and pleasure travel embarrassments.

The map opposite page 216 shows in red lines other improvements needed for Cambridge. Among these there is indicated a short road between Willow Street and Massachusetts Avenue near its junction with Somerville Avenue, to afford a more convenient approach to Davis Square than is now afforded by the roundabout and narrow line of Beech Street. A bridge is also indicated across the Charles from Beacon Street, Boston, at the cross roads to Fowler Street on the Cambridge embankment. The relation of the cost of bridging to the construction of islands in the basin is discussed upon page 218.

The existing connections between Harvard Square and Allston are inconveniently crooked and narrow.

Canton.

See note on page 214; also maps opposite page 256.

The general road plan of Canton is well arranged for the present purposes of the town. As a whole, however, the streets are very narrow. Sherman Street at the library is about 37 feet wide, Railroad Avenue 40 feet, and Washington Street varies from 48 to 55 feet in width. These widths are ample for village conditions (see Fig. 5 opposite page 200), but they are not satisfactory for town or city development. Canton is one of the few communities of the district which has no conspicuous town square, although Washington Street is widened to about 70 feet near the most important stores. One or more of the ponds near the heart of the town should be taken for park purposes.

Charlestown.

See note on page 214; also maps opposite pages 216 and 256.

The high ground of Charlestown forms a remarkably sharp-backed ridge about two-thirds of a mile long and about one-fourth of a mile wide. The southern brow of this hill is so steep that buildings can be erected upon it only with great difficulty. Surrounding this ridge there is a broad fringe of nearly level ground, varying in width from a few hundred feet to upwards of one-third of a mile.

Upon the abrupt slopes of the ridge a rectangular system of streets, very abrupt in gradient, have been built. The east-west system comprises Bunker Hill Street, Tremont Street, Bartlett, Russell and High streets. These thoroughfares are very uneven in profile and have gradients seldom less than 6 per cent. and often as high as 12 or 14 per cent. The north-south system of streets is made up of about 20 different lines of thoroughfares, more or less broken in their alignment. Their gradients are exceedingly steep, rarely less than 10 per cent. and frequently reaching 15, 18 and even 20 per cent. They are so abrupt as to prevent traffic circulation. Circulation north and south is not needed at present and could never be made possible except by the use of tunnels. East

ONE OF THE
POSSIBLE CONNECTIONS BETWEEN ALLSTON AND SOMERVILLE

COMMONWEALTH OF MASSACHUSETTS
METROPOLITAN IMPROVEMENTS
COMMISSION

SCALE 0 1/4 1/2 3/4 MILE

ARTHUR A. SHURTLEFF
22 CONGRESS STREET

LANDSCAPE ARCHITECT.
BOSTON, MASS. JAN. 25, 1909.

EXISTING STREETS BETWEEN ALLSTON AND SOMERVILLE

and west circulation is also unimportant and can be accomplished for light vehicles on the present roads by modifications in profile. To render the development of this district more orderly, to facilitate the use of fire apparatus, and to assist in light traffic communication, the broken lines of east and west communication should be corrected as follows: extend Bartlett Street to Russell Street and the latter westerly to Main Street; connect High Street with Chestnut Street; widen Mt. Vernon Avenue; correct petty profile irregularities by a system of established grades suitable for permanent buildings.

Upon the level ground on the north of the ridge there already exists an excellent thoroughfare in Medford Street, which is level, wide (80 feet), direct, and is admirably placed in regard to the water front adjoining it. On the east side of the ridge is the narrow, rolling Chelsea Street, — an exceedingly important thoroughfare, furnishing the only outlet from Boston toward the north until the route crossing Malden bridge is reached. On the south there is a series of streets nearly parallel to one another which furnish admirable circulation between the ridge and the railway district. These streets, though narrow, are direct and have very comfortable profiles. They are Washington Street, Rutherford Avenue, Main Street, having the elevated railroad throughout its length, and Warren Street. These streets, forming a great triangle about the Charlestown bridge, seem destined to be the great industrial thoroughfares of Charlestown and the main outlets from Boston on the north and northwest. For this reason they should be made ample in width. A legislative act has already been presented for the widening of Chelsea Street, for which $600,000 may be expended, the railway company to furnish $200,000 of this sum. The following streets should be widened amply: Chelsea Street, Washington Street, Henley Street, Warren Street, Austin Street and Chapman Street (between Washington Street and Rutherford Avenue).

Henley, Warren and Austin streets are exceedingly important lines in the north-south traffic of Prison Point Street and Chelsea Street.

Since the narrowness of Main Street, especially near City Square, can hardly be corrected on account of expense, the widening of Washington and Bow streets is especially important because these highways must serve to relieve Main Street while fulfilling their regular duties as branches of Rutherford Avenue.

The junction of Medford Street with Chelsea Street is too roundabout for vehicles going southward and a widening of Tufts Street is needed. (See map opposite page 216.)

Chelsea.

See note on page 214; also maps opposite page 256.

The city of Chelsea was laid out with a system of streets well suited to receive and to distribute the traffic of the communities which surround it. The plan of the city may be described as a composition of

three gridiron schemes, arranged to meet the contours of the ground to the best advantage and to distribute traffic radially to and from a common center. In the most western of these three gridirons a strong diagonal, Everett Avenue, was built to afford direct communication with Everett, independent of the members of the gridiron itself. Broadway leads directly to Revere upon easy gradients, and Marginal Street follows the water front. The plan of the city could hardly be improved except in the minor details mentioned below.

Immediately after the recent fire Chelsea corrected so far as was possible the minor faults of its street systems. Everett Avenue was widened between Arlington Street and Broadway and was extended to Pearl Street. Central Avenue was also widened, and minor streets near Broadway were extended and widened. Land was also reserved for a fine group of school buildings (see Fig. 49, opposite page 210), for a city hall, city stables and other public buildings. In short, the city took advantage of the fire to perfect a plan which was admirable at the start. One fault could not be corrected, however; it was beyond reasonable cost to transform the series of intermediate narrow streets, including Ash, Poplar, Cherry and Division streets, into highways as wide as those in the rest of the city. Those narrow streets were designed, when the city was first laid out, to serve as alleyways to the greater streets which backed upon them. Unfortunately these alleys became independent streets, with private frontages of their own, precisely as the narrow back alleys of South Boston developed into tenement quarters.

Among the admirable features of the Chelsea plan may be mentioned the relation of Crescent Avenue to the railway tracks. This street exactly parallels the track and receives the ends of all the streets of the adjoining gridiron, without ragged dead ends and blind elbows of any kind. Compare this treatment with the characteristic street shown in figs. 17, 18, 19 and 20, opposite page 197. Unfortunately this excellent precedent has not been followed in the instance of Gerrish Avenue. The failure of this street to parallel in the same manner the tracks of the Boston & Albany Railroad has allowed dead ends to be found at Seventh, Marlborough, Grove, Cottage and Watts streets, and at Chester Avenue. The absence of this much-needed extension of Gerrish Avenue also prevents circulation of traffic around the eastern side of Bellingham Hill, and in large measure isolates or pockets the triangle bounded by Central Avenue, Highland Street and the Boston & Albany Railroad tracks.

The desirability of a future bridge connection between Chelsea and Eagle Square, East Boston, is treated at some length under "East Boston," below.

The widening of the existing bridges to Chelsea from East Boston is an improvement which deserves to be undertaken as soon as money for the undertaking is available.

Cohasset.

See note on page 214; also maps opposite page 256.

Cohasset depends upon the rural character of its highways for a large share of its individuality and charm. The narrowness and crookedness of its streets as well as their novel changes in gradient are valuable scenic assets of the town. The local attractiveness of Jerusalem Road as well as the views which may be enjoyed from it explain its remarkable popularity as a trunk line of approach to a community of fine country estates, and as a driving road for that community. Unfortunately for Cohasset and Jerusalem Road the attractiveness of this neighborhood has made it a thoroughfare for automobiles from all points of the district, and now promises to do the road great injury by the widenings which are needed to make it safe for this host of sight-seers. To carry out improvements of this kind upon Jerusalem Road and other narrow ways of the town in the usual rough and ready fashion would be a blow to Cohasset no less than to the sight-seeing public which needs the widenings and grade easements. A destruction or relocation of the boundary walls, fences and hedges which border these highways would not only injure them seriously as pleasure ways but would antagonize the owners fronting the streets, since their elaborate lawns, plantings and fences would suffer immediate and wholesale destruction. It would be a better procedure for the town to take the land necessary for a future street of ample width, but to allow this acquired land to remain in use by the abutters until such time as sidewalks are required. In the meantime the traveled way need be widened only sufficiently to accommodate wheel traffic. The abutters would then be able to withdraw their border plantings, walls and fences by degrees to the new line, and in a course of years the road could be widened without leaving scars of destruction along its new margins.

Certain portions of the remarkably picturesque water front of Cohasset should be reserved for park purposes.

Dedham.

See note on page 214; also maps opposite page 256.

With the exception of the towns of Hingham and Swampscott no community of the district has as narrow streets as Dedham. Few streets of the town exceed 50 feet in width and the majority are less than 40 feet. This is true of the chief streets as well as those of secondary importance. (See diagrams of street widths opposite pages 200 and 202.) The streets of the town are well distributed, however, and with few exceptions have good gradients. Westfield Street, especially at its western end, needs relocation to secure proper gradients, if it is ever to become a thoroughfare.

The town square of Dedham is illustrated in Fig. 25, opposite page

206. It is one of the most singular squares of the district in being formed by a direct set-back of the side line of the street rather than by a rounding or short cutting of the corners of street junctions.

Dorchester.

See note on page 214; also maps opposite page 256.

The importance of forming wide and convenient cross-town lines by the improvement of Ruggles and Norfolk streets, by the improvement of Ritchie, Townsend and Quincy streets, and by the improvement of Boylston and Seaver streets, Geneva Avenue and Gibson Street, is described under the heading of "Roxbury," below. The development of the southeastern extremity of Talbot Avenue through Minot Street is also desirable. Morton Street should be similarly connected with Codman Street, and the latter radically improved in gradient near Washington Street. Walkhill Street should be extended through Grossman Street to Adams Street. Dorchester is well provided with north and south roads to Boston, but a shore road upon the east side of the New York, New Haven & Hartford Railroad is much needed for convenient circulation toward Quincy, and to develop the Dorchester Bay water front. (See the current report of the Metropolitan Park Commission.)

Dover.

See note on page 214; also maps opposite page 256.

The town of Dover is well provided with convenient roads for its present stage of development. These roads follow the midslopes of the hills in order to give approach to hill farm lands. In the future, other roads of more gentle inclination will be needed through the valleys to provide more convenient lines of connection for through travel. The gradients of Farm Street between Springdale Avenue and Bridge Street are evidently primitive in character; the valleys near at hand would provide a more direct course for the road and one free from objectionable steepness.

East Boston.

See note on page 214; also maps opposite pages 216 and 256.

East Boston has four considerable eminences within its boundaries. On the south is the long, narrow ridge culminating in Belmont Square, the slopes of which are so steep as to prohibit traffic circulation across it. On the west is Reservoir Hill, — an eminence which also prohibits cross circulation of traffic. On the east is Wood Island, which has been reserved as a park for the city of Boston. On the north is the Byron Street ridge, — a long flat hill of considerable extent but of such gentle contour on the north, south and east that roads cross it readily upon comfortable gradients. On the west, however, this hill is exceedingly

abrupt, notably near the Boston & Albany tracks. These hills are distributed about the island in such a way that they offer very slight obstacles to the development of the island water frontage, inasmuch as roads of easier gradient pass around them.

The street system is an interesting and satisfactory group of rectangular systems fitted together like a mosaic, with the long lines of circulation inclined at an angle of about 30°.

The lines of contact of these several rectangular systems constitute diagonals and furnish useful short cuts. The streets are uniformly wide and well profiled and the grades are as gentle as the topography will allow. (See plan opposite page 198.)

Two main streets, well connected with the heart of the city, lead by bridges upon the north into Chelsea, and one well-connected street leads directly into Orient Heights and thence to Revere. These connections are satisfactory in the main for the present business of East Boston and Chelsea, but with an eye to the future additional bridge connections are desirable. The map opposite page 216 indicates the strategic importance of Eagle Square and the importance of a bridge to connect it with Chelsea. The need of a connection between Eagle Square and Bennington Street at Neptune Avenue is also apparent. To facilitate traffic movements from the vicinity of the proposed docks two diagonal roads are shown crossing the regular gridiron of streets which lies between the tracks of the narrow-gauge railroad and the Boston & Albany Railroad. One of these diagonals leads to Elm Square and the other toward Maverick Square.

With few exceptions, the marginal roads of the city, giving frontage to wharf property, are good in position and in gradient. They are, however, too narrow if business operations in East Boston should assume the activity which is anticipated. The serious flaws in the water-front streets which need remedy are as follows: —

Condor Street has no northeastern outlet; it comes to a dead end at Glendon Street. It should certainly be extended either in a straight line to Chelsea Street or in a curving line to the end of Shelby Street in order to afford a proper outlet to the Condor Street traffic going northward. The extension of Condor Street will do some damage to the present wharf property, but it is a question if these interests should stand in the way of the service which Condor Street extended could provide for northwestern East Boston.

The junction of Condor and Border streets is too sharp. The corner should be rounded for traffic purposes and should receive additional rounding in case the proposed freight railroad is constructed at that point.

The connection between Marginal Street and Sumner Street at the southern end of the island has never been satisfactory, and of late this unsatisfactory condition has been aggravated by the discontinuance of

Marginal Street west of Orleans Street and by a similar discontinuance of Webster Street west of Orleans Street. The closing of these streets has been necessitated by the solution of the grade crossing problem, the last east and west overhead crossing being on Sumner Street. For this reason Sumner Street must be regarded as the southern border street for wharf purposes, at least as far east as Cottage Street. Beyond that point the grades of Sumner Street are too abrupt to be used for traffic purposes. The marginal circulation about the southern end of the city would be greatly assisted, consequently, by a diagonal street connecting Sumner Street at Orleans Street with the old water front highroad at Cottage Street.

The long streets laid out in East Boston forty or fifty years ago were rendered attractive by rows of trees. Their foliage and trunks form an important addition to these thoroughfares to-day and prevent an appearance of monotony and hardness which prevails in the long streets of more recent date. Trenton Street, Lexington Street, Princeton Street and others are provided with trees, while Chelsea Street, Saratoga Street Extension, Bennington Street and many others lack such plantations and are tiresome and monotonous. This monotony can be relieved in some measure by occasional squares, but the planting of trees will accomplish the object much more readily and satisfactorily.

East Boston is deficient in playgrounds. Wood Island Park, although large in extent, is too far removed from the settled portions of the city to be available for playground purposes. Additional playgrounds should be provided, somewhat as follows: enlarge Decatur Street playground to Maverick Street. A playground should also be provided near the junction of Putnam and Frankfort streets, on the water front at Central Square and in the vicinity of Byron Street.

There can be no doubt that the topographical relation of the island to the marginal traffic streets particularly favors the connection of a marginal freight railroad. Grade crossings would be exceedingly infrequent and in many instances could be abolished.

Everett.

See note on page 214; also maps opposite page 256.

The steepness of the approaches to Everett over the new bridge at the junction of Main Street and Broadway are a serious injury to the city and to the neighboring municipalities which use this main road. The gradient on the Boston side of this bridge approach varies from 4.4 per cent to 4.8 per cent, while that on the east or Everett side varies from 4.4 per cent to 5.3 per cent (measured January, 1909).

A new street nearly parallel to Main Street, but having a much more level gradient, should be built on the line of Bell Rock, Tremont, Elmway, Laurel and Spaulding streets, to afford connection with Malden without climbing the high ground of Everett. A branch should lead

from this street via Parlin Street and the vacant land between Oakes and Winthrop streets to Second Street. Second Street forms a direct connection with Chelsea, and in association with the proposed extension of Bell Rock and Parlin streets should form an important cross-district thoroughfare. An east and west traffic road should also be provided alongside the Revere Beach Parkway. There can be no doubt of the future importance of Levry and Elm streets to the city and to the district as main thoroughfares. They should be widened for this service.

The present square at Everett is too cramped for so important a community, and should either be enlarged or a new square created elsewhere in connection with a group of future public buildings.

Playgrounds are also needed for the remarkably well-distributed schools of the city.

Hingham.

See note on page 214; also maps opposite page 256.

Hingham has two parallel main streets separated from one another only by a few hundred feet. North Main Street forms the direct road to Quincy and to Cohasset, while South Main Street forms a direct connection between East Weymouth and Cohasset. Both streets are exceedingly narrow, averaging only about 42 feet in width, and having constrictions of 38 feet. They are also exceedingly crooked and are occupied in part with electric-car tracks. The importance of these streets to the district requires either that one of them should be widened or that a new street of ample width should be built to accommodate the south shore traffic, which is now inconvenienced by these narrow and crooked highways.

Harbor Street should be widened and made the logical approach to Otis Street and Downer Landing. Ship Street, with its prohibitive gradients, can never form a proper extension of Otis Street for other than the lightest of vehicles. Summer Street should be improved in line, gradient and width for the safety of south shore travel.

The main street of South Hingham is in striking contrast with the other highways of the town. This thoroughfare, which is one of the finest in the district, rarely falls short of 60 feet in width, and for miles it measures over 100 feet, while at many points its total is 200 feet from property line to property line.

Upon the hilly ground at Crow Point, Downer Landing, is an example of the unfortunate consequence of laying out upon a steep hill a system of streets which mount its slopes regardless of gradient. So precipitous are the roads upon this hill that light power automobiles are wholly unable to mount them and only the lightest laden draft vehicles may traverse them. On page 198 is given a description and illustration of a hill of similar steepness in Brookline, upon which roads of easy gradient have been built.

Hull.

See note on page 214; also maps opposite page 256.

The streets of Hull resemble those of Nahant in being largely isolated from the main highways of the main land. The ocean drives and the metropolitan reservations of the peninsula, however, attract great numbers of visitors from the district, and the condition of the roads of the town, therefore, affects the community at large in an intimate way. The approaches to Nantasket beach are narrow and crooked and irregular in gradient. This gateway to the peninsula should be radically improved for the comfort and safety of a large pleasure-seeking public. The Straights Point Road should also be improved for a similar service. County Road, which forms the backbone of the peninsula, should be widened from the reservation northward, and the approaches to Hull proper also need widening. The road systems of Allerton Heights and the other uplands of the town are laid out with streets which pay no heed to the steepness of the ground, but which mount with prohibitive gradients hills which deserve a system of roads calculated to conserve the desirability for residential purposes rather than to waste many of their resources. The illustrations on page 198 indicate a road system laid out upon Aspinwall Hill, Brookline, which provides easy approach to a hill as steep as that at Point Allerton.

Hyde Park.

See note on page 214; also maps opposite page 256.

A new road upon easy gradients is needed from Clarendon Hills station to East River Street near Wood Avenue, largely through vacant land but partly across the line of Huntington Avenue. The abrupt topography upon the east and west sides of the town forbids east and west roads of importance and places great dependence upon the valley roads of the Neponset River. These roads are partly ensured by the metropolitan park reservations along this stream, but the town should extend and perfect its own valley streets to form continuous traffic lines. Brush Hill Road furnishes a picturesque driving road of great value to the community, but its gradients are not suitable for an important district thoroughfare.

Lexington.

See note on page 214; also maps opposite page 256.

Lexington belongs to that type of town having only one longitudinal street of the kind described on page 196. This main street is wide and amply provides for the present needs of the town, but other streets parallel to it should be developed for the reasons given at length on page 196. To accomplish this purpose, Sherman Street should be extended to Oakland Street, and thence parallel with the railroad

tracks to the main road. A similar road, approximately parallel with Massachusetts Avenue, should be developed either on the line of Highland, Forest or Parker streets, or on a combination of one of these streets with a new street.

Traffic between Woburn and Lexington is assuming proportions of sufficient magnitude to deserve a relocation of Woburn Street upon a line which will allow proper gradients to be secured. The present course of this street does violence to the best principles of road location, and to attempt to cut down its severe gradients would be a waste of money. The valley at the north of the road offers a good opportunity for a new location of an economical kind.

Lexington Common (see Fig. 23 opposite page 206) is unquestionably one of the finest squares of the district.

Lynn.

See note on page 214; also maps opposite page 256.

The city of Lynn occupies a tract of rolling ground hedged in between the sea and the rugged highlands of Swampscott, the steep hills surrounding Flax Pond, the cliff-like front of the Lynn woods and the marshes of the Saugus River. Almost the whole of this comparatively level tract is now occupied with streets, and the city has no opportunity for further growth without overcoming the natural barriers which surround it upon all sides.

The hill barriers are now being overcome upon their edges by a series of streets laid out by private landowners without regard to the steepness of the ground. The city should discourage to the utmost the precipitous and dangerous streets which are being built east of Eastern Avenue and upon the steep front and V-shaped valleys east of the Lynn Woods. These highlands should be mapped out with a sufficient number of radiating streets of proper gradient to prevent the present land-development projects from strangling the city with a tangled network of impossible highways.

Upon the southerly or marsh end of the city other obstacles are confronting the street system and have already mutilated it. These obstacles are the extension of freight yards and the enormous industrial plants upon the borders of the tidal areas. While this type of obstacle is a tribute to the prosperity of the city, it should not be allowed to grow faster than the highway system, and thereby cut the city off from its most promising future field of development upon the level ground to the south. That is to say: Lynn should provide itself with additional highways leading toward Revere and Boston. At present only two lines of road, the Boulevard, or Lynn Shore Road, and Western Avenue, lead in this direction. The first of these streets connects in Revere only with a pleasure road which is forbidden to traffic use. It is impossible to believe that these two streets in con-

junction with the road to East Saugus are sufficient for the future growth of Lynn upon its most promising side. The map opposite page 256 shows a scheme of new roads in this district which might be laid down with reasonably good connections with the present main roads of the city.

At the eastern point of Lynn only three streets lead onward into new territory, — Ocean Street, Essex Street and Western Avenue. This small list should be increased. By co-operation with Swampscott it would be possible to effect this desirable increase by extending Columbia Avenue and New Ocean Street to Paradise Road, as shown on the large folded map and as described under "Swampscott."

The abortive condition of the main highways leading from the margins of Lynn on the south and north is reflected naturally enough in the interior of the city. Union Street comes to a serious halt at Chestnut Street; Broad Street shrinks from its splendid width upon joining Lewis Street; Columbia Avenue closes with an elbow at Brookline Street; Wheeler Street ends at Blossom Street; while Bennett and Neptune streets are cut in two. Upon the northwestern side of the city the only outlet of the future must be, in virtue of the topography of the hills, through the Flax Pond valley, and yet the roads leading through this gateway are primitive in width and alignment; that is to say, Eastern Avenue should lead into Waitt Avenue, Maple Street and Euclid Avenue, and thence along the eastern borders of Flax Pond, by a series of properly connected and ample roads, to Broadway. At present these connections are dangerous or lacking. Upon the west side of the pond it would be desirable to extend Goldthwaite Street through Graves Place, and Ramsdell Place to Broadway in order to relieve Chestnut Street of the sole burden of this valley outlet. The importance of the Flax Pond valley roads to the Lynn Woods for pleasure purposes should be borne in mind, but the chief reason for arranging the streets of the city to lead conveniently toward this valley is wholly one of practical utility.

The street improvements needed in Lynn may be described briefly in the following list: —

Extend Union Street to Ireson Avenue and thence through Brookline Avenue to Brookline Street, thence to Columbia Avenue and Paradise Road (see "Swampscott").

Extend Eastern Avenue through Waitt Avenue, Maple Street, Euclid Avenue and along the easterly borders of Flax Pond to Broadway.

Extend Goldthwaite Street to Broadway.

Extend Marianna Street to Eastern Avenue.

Extend Howard Street to Bloomfield Street and Sanderson Avenue to Superior Street.

Improve the gradients of New Ocean and Ocean streets.

Widen Lewis Street.

Extend Wheeler Street to Charles Street and Charles to Bennett Street.

Connect Neptune Street with West Neptune Street.

Extend Linwood Road through Forest Street and Franklin Court across the west side of the cemetery knoll to Boston Street.

Ease the gradient of Fayette Street between Collens and Marianna streets.

Widen Lawton Avenue and ease its gradients.

Provide additional highways toward Boston and Revere upon the south (see maps opposite page 256), between the Revere Beach and the Boston & Maine Railroad.

Lynn is one of the most prosperous cities in the Metropolitan District if not in the State, and its highways should be designed to assist the future development of the city. The business spirit of Lynn resembles that of western cities, and the community should undertake highway improvements with confidence that convenient roads are not a luxury but a necessity to a modern community.

Malden.

See note on page 214; also maps opposite page 256.

The street plan of the city of Malden is similar in many respects to the typical town plan given opposite page 196. That is to say, the city has only a few through streets capable of handling the cross-town traffic of the city, and the majority of the other streets end in bad jogs or dead ends and can share no part in important traffic. Moreover, the main streets are too narrow to accommodate four lines of vehicles. (See figures opposite pages 200 and 202.) To widen these streets would be very costly, and the city should therefore begin to develop its rudimentary side streets to relieve the inadequate main highways. These improvements may be briefly described as follows: —

Widen and extend Oliver Street to Waite Street, extend Waite Street to Howard Avenue, and connect the latter by ample widenings and easements with Eastern Avenue; also connect Eastern Avenue directly with Charles Street by a new road across the Saugus Branch Railroad from the corner of Charles and Middlesex streets. This series of extensions would provide the city with another through east and west street.

Connect Medford and Cross streets at Main Street with a short diagonal road to correct the present jog.

Connect Maple Street and Mountain Avenue by a similar diagonal to relieve present traffic interruption.

The realization of the much-needed connection between Glenwood Avenue and Highland Avenue will produce another incipient east and

west through line needing a better junction between Forest and Winter streets, and an improved profile of Glenwood Street at the new school, as well as liberal widenings to make it of lasting service to the city. This new street should relieve Maple Street of much of its present travel. Bowman Street should be extended to Broadway.

The north-south streets of the city are also rudimentary in character and need the following connections to make them of service in relieving Main Street and Central Square and in accommodating long-distance traffic between Boston and Melrose, Wakefield, Stoneham and Reading: — Extend Green Street to Jackson and Jackson to Washington Street, and improve the narrow and crooked line of the Washington Street bridge. (See under "Melrose" the improvements advocated for the northern limits of this street.) Lebanon Street should be extended in a southerly direction to Broadway near Lea Street. (See Lebanon Street improvements advocated for Melrose.) Willard and Rockwell streets should be connected.

Maplewood Square (Fig. 32, opposite page 206) should be enlarged. (See Watertown and Village squares opposite page 207.)

Malden is well provided with playgrounds and parks.

Medford.

See note on page 214; also maps opposite page 256.

Harvard Street, Medford, should be extended across the vacant land of the old Mystic trotting park in connection with the Allston-to-Davis Square highway, illustrated in the plan opposite page 222. At some future time Harvard Street should be further extended across the Mystic River to the junction of Spring Street and Riverside Avenue, and thence across the clay pits to Quincy Street, to form a main cross-district thoroughfare. Central Avenue should be carried through to Salem Street to provide circulation with Malden independently of Salem and Pleasant streets. College Avenue (widened) should be extended through Walnut Street across the river to High Street at Governor's Avenue in order to relieve the narrow main street of a portion of its traffic. Winchester Street should be connected with Orchard Street to form a through line parallel with the Boston & Maine Railroad. Playstead Road, Canal Street, a portion of Prescott Street, West Street and South Street should be connected and widened to form a main line of connection, upon good gradients, between Medford and West Medford. The narrow and steep High Street provides the only connecting link between these portions of the city at present. The dead end or appendix of Canal Street at its junction with Arlington Street should either be blocked or extended, to prevent it from serving as a maze to entrap strangers. An enlargement of the square at the junction of High and Grove streets should be made to correct the dangerous angles

of approach of this open space and to give it a dignified appearance. Grove Street needs improvement in line, gradient and width. An extension of the border road of the Fells Reservation is needed from the west dam to Highland Avenue, Winchester, to form a convenient short cut to Medford.

Melrose.

See note on page 214; also maps opposite page 256.

The city of Melrose resembles Malden in the broken connections afforded by its side streets. In this respect it resembles the plan of a typical town, shown opposite page 196. Melrose has only one east and west through street, and only one north and south through street. For reasons which are given at length on page 196 other continuous streets should be developed from the present rudimentary streets, as follows: —

Connect the following streets to make one uninterrupted line: Greenwood, Melrose Place, Vinton, Florence, Washington; also connect Pleasant, Hurd and Florence. Connect Lebanon, Linwood and West Foster. A continuous through road should also be developed from the following connections: Swains Pond Road, Ninth, Lincoln (part of), Fletcher (part of), Elm (part of), Linden, West Linden. A branch should be created from this road at Fletcher Street, leading northward through Nelson Street and Damon Avenue, as shown on the folded map.

The proposed parkway, already partly built to the Lynn Woods, will afford a much-needed east and west road. Grove Street should be connected directly with Wyoming Avenue to form another cross-town line. Most of the main roads of the town are too narrow. (See diagrams opposite page 200.)

The city should secure as public property the remarkable cliff on Upham Street near the Saugus line.

Fig. 43 opposite page 210 indicates the present state of development of the group plan of the important buildings of the city.

Milton.

See note on page 214; also maps opposite page 256.

Milton is one of the few municipalities of the district which has wide roads other than those which lead directly to Boston. Edge Hill Road measures over 60 feet in width, and portions of the Brooks Road and White Road exceed 75 feet. Neither of these streets is continuous at its maximum width, and should be extended. Eliot Street should be made a wide through street from Central Avenue to Mattapan, and should connect with a new road following the river to Readville Center, and Pleasant Street should be widened. Brush Hill Road should be improved as a through road; it varies from 30 to 50 feet in width. Canton Avenue is about the same width and is also dangerously crooked

and steep, though exceedingly picturesque. These thoroughfares have become so popular as automobile routes that public safety requires their improvement.

Nahant.

See note on page 214; also maps opposite page 256.

The street system of the town of Nahant, like that of Hull, is nearly isolated from the highways of the main land, and to that degree relates only in small measure to the road problems of the district or of neighboring towns. Upon the other hand, the seashore roads of Nahant are frequented by hosts of pleasure seekers from the inland towns and possess to that degree metropolitan importance.

Like most hilly towns of the district Nahant was laid out with roads which climb its hills abruptly, without regard to gradient. (See plans opposite page 198.) This is of little consequence to the town in its present state of development, but as time goes on these roads will offer serious obstacles to the convenient and economical use of property. The day is past when these faults can be wholly eliminated, but their disadvantages can be relieved in part by perfecting the more important roads. Nahant Road, Castle Road and Willow Road should be widened and their abrupt gradients reduced in steepness. They should also be united to form a loop or circuit road embracing the peninsula. Evidently this work could not be executed at once on account of its expense, but it should be accomplished by a series of yearly improvements planned at the start to achieve a definite result at the end of a definite period of years.

Needham.

See note on page 214; also maps opposite page 256.

Highlandville and Newton Lower Falls deserve better connection than that afforded by Cedar Street. This road has very severe gradients at the aqueduct and at Boylston Street, Newton, and needs relocation. The connection between Kendrick bridge and Highlandville also needs improvement in gradient.

As a whole, the street plan of Needham is good, and improvements of width and gradient are more commonly needed than new streets. The town should discourage streets like West Street, Highlandville, which, though smooth in surface, is dangerous to life and limb on account of its steepness, and encourage streets like Greendale Avenue, which in spite of its rough surface is well placed with regard to the slope of the ground, and can be perpetuated without radical changes as an admirable through street. Great Plain Avenue, except near the town square, is too narrow for a main street. Highland Street is also too narrow. (See discussion of street widths on page 200.)

Newton.[1]

See note on page 214; also maps opposite page 256.

Newton is crossed by five of the great radial thoroughfares leading from Boston: Boylston Street (Framingham turnpike), Beacon Street, Commonwealth Avenue (Newton Boulevard), Washington Street and Watertown Street. These roads vary widely in their gradients, — Commonwealth Avenue and Boylston Street being exceedingly hilly, Beacon Street slightly hilly, and the others comparatively level and well suited to the heaviest traffic.

The branches of these main thoroughfares are with few exceptions well placed with regard to the topography. The needed improvements in this secondary road system may be described as follows: —

Auburndale should be more intimately connected with West Newton by a new road along Cole Brook or by a development of the eastern end of Webster Street. To one unacquainted with the present tortuous line of Webster Street and Wolcott Street, Auburndale seems to lack connection either with Watertown Street or Washington Street.

Waban also needs more direct connection with Auburndale by a new road following the easterly branch of Cheese Cake Brook (below Fuller Street), and connecting with Chestnut Street near Moffat Road. (See maps opposite page 256.) This improvement would also provide an approach to Waban from West Newton upon almost level gradients. At present, Chestnut Street with its long-continued steep gradients, and Fuller Street with its bad gradients at its westerly junction with Commonwealth Avenue, furnish the only northern approaches to Waban.

Harding Street and North Street should be connected by a new road to allow Waltham Street traffic to cross the Charles via the North Street bridge. (See "Waltham" for a description of the northern extension of North Street to Belmont.)

A new bridge is needed over the river at Allison Park to connect with Howard Street in Watertown. Alteration plans for this improvement were made by the late City Engineer Farnham. The importance of this bridge as a part of a scheme for a continuous cross-district road is shown on the folded map. This improvement has an important and favorable bearing upon the proposed parkway scheme, prepared in its details by Mr. H. J. Kellaway and presented by a committee of Newton and Brookline citizens to the Metropolitan Improvements Commission. This plan provides for an intimate connection between the new Galen Street bridge at Watertown and the West Roxbury Parkway via Cabot Park, Hammond Pond and the Putterham Meadows, and is heartily to be recommended as a parkway.

[1] Including Newton, West Newton, Newton Center, Newtonville, Newton Highlands, Newton Upper and Lower Falls, Auburndale, Waban.

Quincy.

See note on page 214; also maps opposite page 256.

An examination of the topographical map will show that Quincy occupies a tract of land which forms a natural gateway connecting Boston with the south shore. This gateway is bounded on one side by the sea and on the other side by the abrupt slopes of the Blue Hill range; therefore traffic cannot be diverted from it, and the main roads of Quincy, which control this gateway, should have sufficient width to satisfy the demands which the future is likely to make upon them. There are only two roads — Adams Street, 40 to 50 feet wide, and Hancock Street, 50 to 60 feet wide — which approach the gateway from the north, and they join to form one road at Quincy Square. That these streets should be widened for the good of the district and the city of Quincy there can be no doubt. To assist these streets, the rudimentary, narrow or ill-connected streets which approximately parallel them should also be developed. Willard Street, Franklin Street, Newport Avenue, Newbury Street, Faxon and Rawson roads require widening, connection and extension to perform this service. The extension of the Quincy Shore Drive through Park Lane, Valley Street, Canal Street and Revere Road would tend to the same desirable end. Traffic should not be concentrated in Quincy Square.

The character of the cross streets of Quincy is of little importance to the district for they can never be of moment as through roads. For the local interests of the city, however, several improvements are needed. Squantum Street and the narrower portions of Elm Avenue should be widened. The jogs should be removed from Beach Street. East Howard Street should be widened and extended through Cleverley Court.

Quincy should not allow the hilly portions of the city to be developed with systems of streets like that of Wollaston (see plan opposite page 198), which represent the worst possible scheme of highways which can be devised for hilly ground. Steep hills of the Wollaston type can be laid out with roads of easy gradient, which are economical to maintain and which are of lasting service to the community.

Quincy Square is illustrated in Fig. 27, opposite page 206.)

Revere.

See note on page 214; also maps opposite page 256.

The most conspicuous features of the map of Revere are the two lines of railroad paralleling one another behind the beach, and the two lines of highway, one immediately on the beach itself adjoining the railroad, and the other pursuing a course through the midst of the marsh district in a straight line. The railroad situation is an exceedingly simple one at present, inasmuch as there are no freight yards and no large stations.

Passengers are dropped at frequent intervals at the west of the Revere Beach Reservation and at the main stations of Revere and Beachmont. The presence of so many tracks places a severe handicap on the development of east and west through roads because it is difficult to cross the tracks without very abrupt approaches and at great expense for bridges. As a consequence, the railway crossings are few, and the east and west system of streets behind the Revere Beach Reservation is very badly organized. It should not be supposed from the above that the north-south streets are by contrast excellent. On the contrary, there are only two streets connecting Revere with Lynn, and one of these, the Revere Beach Parkway, is limited to use by pleasure vehicles. The future will certainly require many more connecting highways between Lynn and Revere. (See recommendations below.)

Between the railway tracks a floating population is springing up, housed in exceedingly small and temporary buildings abutting upon short streets in nowise related to the future need of main highroads between Lynn and Boston or between Revere and Boston. Undoubtedly this character of development is a natural one for Revere, in view of its service as a public recreation district, but it seems quite necessary to provide future north and south highways through this tangle of small streets. If these main highroads can be assured, it makes little difference to Revere or to Lynn and Boston what may happen in the intervening spaces, — they may be cut up in any way suitable to the demands of the local population.

An examination of a contour map of this town shows very clearly that thoroughfares of easy gradient cannot be distributed over the town at random. Such important roads can only pass through the valleys, — they must all articulate with three focal points, *i.e.*, Broadway at Paul Revere Park, Upham or Everett Street near the Revere station, and Waverley Street or Garfield Avenue in the vicinity of the Beachmont station. It makes very little difference whether the roads upon the steep hills between these focal points are on good line or good grade so far as the general public is concerned, but so far as the local householder is affected the disposition of these streets upon the abrupt sided drumlins is a matter of serious importance. Payson's Hill and Fenno's Hill are partially covered with a rigid gridiron system of streets, a very large proportion of which are steeper than 10 per cent. The streets upon Young's Hill have been arranged with somewhat greater regard to the contour of the ground, but the street profiles, however, at certain points have prohibitive inclinations. Many of these streets have gradients of 15 per cent. Beachmont was apparently laid out with the general notion that curving streets were bound to fit a steep hill, but the realization of the street system is a melancholy one. Most of the east and west streets are impassable or are abandoned wholly and supplanted by stairways. The east and west streets are

generally satisfactory on the crest of the drumlin but at the extremities a 12 per cent. grade prevails. It happens that the most direct line of road between Revere (Charles Eliot Circle) and Winthrop is one of those which mount the slopes of Beachmont with steepness. Evidently some better line is necessary.

The highway improvements recommended for Revere may be summarized as follows: —

Provide a main thoroughfare through Upham Street and thence northward through Hawes and Elmwood streets toward Oak Island. Although in its eventual form this road should continue to parallel the tracks of the Eastern division of the Boston & Maine Railroad to Lynn, at the present time, at least, it must turn off through Oak Island and join the Revere Beach Parkway at the southeasterly bend of Pines River. (See maps opposite page 256.)

Provide a through line of road from Beachmont through Waverley Avenue, Otis Street, along the easterly borders of Wonderland Park, through Waban Street to the Oak Island bridge over the Boston & Maine Railroad. In the future this road should be extended to Lynn but at the present time it might nearly join the Revere Beach Parkway just north of Oak Island.

Provide a road from Beachmont station along the borders of Belle Isle Inlet to Winthrop, the purpose being to allow circulation between Point Shirley and Winthrop with the mainland without climbing heavy grades.

The profile of Broadway should be eased in the vicinity of Revere and Malden streets.

Widen Atlantic Avenue from the Charles Eliot Circle vicinity to Belle Isle and southward to connect with the great East Boston boulevard to join it with the proposed through street approximately upon the line of Waverley Street and Otis Street, as above described.

The westerly side of the block of land between Library Street and Winthrop Avenue on Beach Street is occupied by two fine municipal buildings which form the beginnings of a group of considerable importance. Sites should be provided for another row of public buildings facing the first row, and having between them a planting strip or mall of considerable width.

Roxbury.[1]

See note on page 214; also maps opposite page 256.

Roxbury is well provided with through roads leading north and south, although they are too narrow for the service they perform. The east to west streets fail to provide proper transverse circulation, and should be radically widened to form adequate thoroughfares

[1] See "West Roxbury," page 252.

for cross-town service. Ruggles Street should form a main trunk road in connection with Cottage Farm bridge, Audubon Road, the Fenway, Hunneman and Norfolk streets. To widen Ruggles Street through its entire length, including Eustis Street, was practicable twenty years ago, but to-day a cheaper and in many ways a better route can be found by branching at Madison Square into Hunneman and Norfolk streets, which are level in profile and have few permanent buildings. Longwood Avenue should be extended through Prentiss and Linden Park streets to Dudley Street to form a similar transverse (circumferential) thoroughfare. Heath, Ritchie, Townsend and Quincy streets should also be widened to form another cross road of metropolitan importance. South Huntington Avenue, Boylston, Chauncy and Seaver streets should be linked with Geneva Avenue and Gibson Street to form a similar trunk line.

Without the improvement of these cross streets of Roxbury and Dorchester the city of Boston and the Metropolitan District can neither develop symmetrically nor enjoy convenient or economical intercourse.

Saugus.

See note on page 214; also maps opposite page 256.

This township is situated on the upper waters of the Saugus River and occupies the even ground of an alluvial terrace. The streets of the town are, therefore, generally level.

The public buildings and dwellings cluster about the meeting point of two main north-south, east-west thoroughfares. Central Avenue is the northern of these thoroughfares and makes a fine connection on the north with Wakefield and on the south with Cliftondale and with the probable future highroads to Revere. The east and west highway, known as Main Street and Woodbury Avenue, makes a good connection on the west with Melrose, but comes to an abrupt termination at the Saugus River, failing to make a desirable connection with Lynn. This connection is supplied in a roundabout way by means of Winter Street, which allows communication with Lynn through East Saugus.

At the northern edge of the town, adjoining Appleton Street, there is a tract of land known as Lily Point Grove, which furnishes a popular outing place for the local community. Although this tract is owned privately it deserves to be made a public park. It contains a pine grove of unusual beauty, together with a lagoon bordered by cliffs rising to a height of 25 to 30 feet immediately from the water. The borders of the Saugus River also present landscapes of great beauty, which should also be set apart for parks. Reservations of this kind should be made with care, however, to conserve the usefulness of the river for manufacturing sites. Although there are at present only a few mills upon the stream, it possesses a recognizable commercial value.

The street improvements needed in Saugus may be summarized briefly as follows: —

Extend Main Street through Woodbury Avenue to East Saugus by way of the Twin Spring Road and the lower and better portion of Hesper Street; improve the line and grade of the western portion of Hesper Street.

Relocate the main road between Birch Pond and North Saugus to secure better gradients. A road of such importance should not be allowed to become permanent upon such a poor location.

The village of Cliftondale is built upon gently rolling ground, having a few abrupt eminences. The street system focuses in Lincoln Square at the junction of Lincoln and Jackson streets; the former street leads directly to Lynn through East Saugus on comfortable gradients, while the latter leads southward to Maplewood and Revere. The size of this square is not commensurate with its importance to the community. (See plans of Brookline and Watertown squares, opposite page 207.) It deserves to be enlarged to make it a permanent center of importance.

The street system of the town as plotted upon a map seems to lack system of any kind, but when studied upon the ground it is seen to be wisely planned. The streets are ingeniously fitted to the irregularities of the ground and usually have good gradients. There are some exceptions to this rule, notably upon Main Street near Third Street and upon Grove Street.

For some years a proposition has been on foot to extend Ballard Street from Western Avenue to the Point of Pines. Bristow Street somewhat further south, as well as Endicott Street, also furnish important "leads" toward the Revere shore. Any one of these three streets if extended would make satisfactory communications with the Revere water front.

East Saugus promises to become a center of some importance in the future. To anticipate this development Franklin Square (see Fig. 21, opposite page 206) should be enlarged. At present it furnishes only limited standing room for a flag staff and watering trough.

A more direct road connection should be provided between Franklin Park Station and Melrose by the extension of Essex Street. (See maps opposite page 256.) A road should also be built on the east side of Baker Hill to allow traffic between Malden and Lynn and to avoid the crowded streets of Franklin Park and Cliftondale.

The village of Lynnhurst is well situated on Walnut Street near Birch Pond. This thoroughfare provides direct communication between Lynn and Wakefield. Unfortunately, many of the lesser streets of the village have been built on very severe grades, notably Washington Street, which has a gradient approaching 15 per cent. The village should not allow itself to be handicapped by an extension of streets upon these prohibitive grades.

Somerville.

See note on page 214; also maps opposite pages 216 and 256.

Somerville, like Cambridge, possesses a much more highly organized plan than that of the typical metropolitan town shown upon plan opposite page 196. Few changes are needed or would be possible in the street plan of Somerville. A southern outlet from the Wellington bridge to the Harvard bridge is needed, however, and an extension of Harvard Street across the Mystic River. (See "Medford.")

The plan opposite page 222 shows a needed connection between Davis Square and Allston via Dover, Hollis, Yerxa and Fayerweather streets.

South Boston.

See note on page 214; also map opposite page 216.

South Boston is about twice the area of Charlestown and is slightly larger than East Boston. About half its area has been reclaimed from tidal marshes and the Old Fort Point Channel. Of this filled portion only about one-third has been developed, although the opportunities for development as regards railway and water connections are remarkably good. The longest dock on the Atlantic coast is lying nearly idle there, awaiting railroad connections and the highway approach just provided by Northern Avenue. The street system is formed of two rectangular gridiron systems inclined at an angle of about 135°. This difference in angle marks an ingenious attempt of the original designer (Mathew Withington, 1804) to adjust a rectangular system of streets to the topography of the ridge. This attempt was partly successful but failed very markedly on Telegraph Hill, where the grades mount to 15 and 20 per cent. So steep are the grades on Linden and Pacific streets that coal and ice wagons can only approach them from above by ascending neighboring streets of easy gradient. The blocks are almost universally 500 feet long and 300 feet in depth. A central alley way was provided in the West Broadway district subdividing each block, making two lots each about 150 feet in depth. These alleys were intended to be used as stable frontages for elegant residences backing upon them. This expected development never took place, however, and the alleys are now used almost universally as streets for the frontages of small tenements and cramped private dwellings.

The recent connection with Boston afforded by the extension of Northern Avenue represents a most important improvement, since it ties the future docks of the northern portion of South Boston closely with the Atlantic Avenue water front of Boston.

Congress Street forms another important connecting link with Boston. Summer Street is the most important thoroughfare uniting South Boston and Boston. It is an artery of great width and excellent profile,

and elevated upon embankments and viaducts to avoid interference with railway circulation beneath it. The old Washington Avenue bridge forms perhaps the least-needed communication with the mainland. It has been out of commission for some years and there seems to be no strong movement to repair it at present.

Dorchester Avenue, which furnishes another important connection with South Boston, follows a very crooked course. Plans are on file in the city engineer's office for straightening the most pronounced bends, and these improvements are to be carried out when funds are available. The street is built on good grades but is much too narrow from Fort Point Channel southward. Dorchester Avenue promises to be one of the great arteries of the Metropolitan District and should unquestionably be widened.

The extension of Atlantic Avenue over the tracks of the New York, New Haven & Hartford Railroad furnishes a communication with the wholesale district of Boston which would be admirable were the profiles easy. Unfortunately they are so steep (5 per cent.) that only light vehicles can climb them; hence the costly new bridge represents an extravagant and unjustifiable waste of public money.

Broadway furnishes an approach to the higher portions of South Boston and is a thoroughfare of great importance. It deserves to be widened west of Dorchester Avenue. East of Dorchester Avenue its width is ample at present. Dover Street also forms an important line of communication.

There is a long stretch between Dover Street and Southampton Street lacking any communication with Boston. The citizens of South Boston and of the South End feel that additional communication across this district is necessary. To furnish such communication would be difficult and would involve some injury to the water traffic of the South Bay. If the South Bay is to be filled, however, an east and west communication between West Seventh Street and the end of Malden Street at East Dedham should be made. The importance of such a cross-town line will be increased when Old Colony Avenue is completed with its Quincy extension. Southampton Street furnishes still another line of communication with Boston. Its point of articulation in South Boston is known as Andrew Square; from this point also radiate Dorchester Avenue, Boston Street, Dorchester Street and Preble Street. The latter street is wholly inadequate as a connection between Columbia Road and Andrew Square and should be widened. It is now a mere village lane.

If we eliminate from consideration of the area of South Boston the high ground which is traversed by streets too steep for traffic to mount readily, we discover how essential to the business success of the level district are the streets of more gentle inclination bordering the high land. The success of the whole water front of South Boston depends

quite as much on the character of these border streets as upon the main streets leading to Boston. On the south, East Ninth Street with its extension to Columbia Road furnishes an admirable traffic street. Columbia Road itself furnishes a traffic thoroughfare which could hardly be equalled, though in its Strandway extension along the shore of the shallow Old Harbor it is associated at present with park developments which make it of no use whatever for dock purposes. On the east, Q Street connects with Columbia Road and allows good circulation for heavy vehicles. On the north, First Street provides similar service for heavy traffic as far west as H Street. At this point, unfortunately, First Street comes to an abrupt end, and allows traffic circulation to continue only by the relatively steep gradients of H Street. This is a marked flaw in the street system of South Boston and should be corrected by extending East First Street westerly until it meets West First Street, which can be accomplished on very gentle gradients. West First Street furnishes a good traffic road for the remainder of the northern margin of South Boston for vehicles moving into Boston proper by way of Dorchester Avenue, but for vehicles wishing to reach Broadway bridge, West First Street is not well arranged. A traverse of some sort is necessary into West Second Street. This can be arranged without destruction of buildings at B Street, as shown on the map opposite page 216. Were East First Street and West First Street connected with one another as described, and united by a diagonal with West Second Street, they would form a link of great strategic importance to South Boston, and little concern need then be felt for the development of the whole tract between West First Street and Summer Street because this area would find suitable outlet by way of Summer Street and West First Street, no matter how badly the intervening streets might be arranged. On the west, Dorchester Avenue forms the natural border street, but one which needs widening. On the southwest, an excellent border street will be created by Old Colony Avenue.

It will be remembered that the street profiles of Charlestown are crudely abrupt, and that a system of established grades is needed there. In South Boston, however, the street profiles are generally as good as they can be made without extravagant outlay. There are a few profiles, however, which need modification; East Fourth Street near its junction with Marine Park has an abrupt profile for a distance of about 200 feet, which is a drawback to property in the neighborhood because it prevents the ready circulation of vehicles of even moderate load. East Eighth Street also has a bad profile in the neighborhood of Lowland Street and Mercer Street.

The extreme southwesterly portion of South Boston possesses a tangle of streets without proper alignment or proper terminations. Alger, Dorr, Woodward streets and others near by should be extended and widened to allow their neighborhood to develop in a wholesome

way. Many streets bordering Preble Street are open to the same objection and should be widened and extended. Evidently these narrow streets contribute valuable service to the community at present for small private dwellings and for small tenements, but it is only a question of time when the tenements and dwellings bordering these streets will require enlargement, and will then suffer in light and air from such a narrow fronting street. If these streets are to be widened, the improvement should be carried out while they are still in the wooden period.

South Boston is amply provided with parks. The great Columbia Road Parkway and the astonishing City Point Pleasure Bay, together with the smaller interior parks and playgrounds, need no supplements at present.

Telegraph Hill, or Dorchester Heights, which was the site of the American batteries which led to the evacuation of Boston by the British, has always been regarded as a great national landmark. A monument has been built upon this spot and is visited by hosts of sight-seers. Unfortunately, it is hidden from view from most quarters, and as time goes on will be wholly hidden from the parkways of Dorchester Bay. To create a footway or a species of stepped mall connecting this monument visually with Columbia Road would be desirable. (See plan opposite this page.) The monument might be thus maintained as a permanent landmark as viewed from Columbia Road, and one ready of access to pleasure seekers even when all the property on the south side of Dorchester Heights is built up with tall buildings. (See also the scheme for a similar vista to the monument in the recent report of the Boston Society of Architects.)

The South End.

See note on page 214; also map opposite page 216.

This portion of Boston may be defined in general terms as the district bounded by Dover Street, the South Bay, Northampton Street and the Providence Railroad tracks. The ground within these boundaries is nearly flat and the streets are laid out upon a nearly regular gridiron. In spite of this uniform arrangement, however, the locality possesses certain individualities in consequence of the presence of shapely squares, of tree planted streets and numerous large churches, schoolhouses and other public edifices.

The most noticeable feature of the street system of the South End is the five great parallel thoroughfares, — Albany Street, Harrison Avenue, Washington Street, Shawmut Avenue and Tremont Street. They contribute much to the unity and monotony of the South End while furnishing a most direct and convenient connection with Boston proper.

Lateral circulation to the southeast and northwest is also well provided for, though nearly half of these cross streets are interrupted by the railway on one hand and the South Bay on the other. To carry

THOMAS PARK
DORCHESTER
HEIGHTS
MONUMENT
PLAYGROUND
SOUTH BOSTON
HIGH SCHOOL
THOMAS PARK
E. EIGHTH ST
V-I-S-T-A
COLUMBIA ROAD
LANDING
DORCHESTER BAY
COMMONWEALTH OF MASSACHUSETTS
METROPOLITAN IMPROVEMENTS
COMMISSION
SCALE
ARTHUR A. SHURTLEFF
LANDSCAPE ARCHITECT
21 CHARLES STREET
BOSTON, MASS. JAN. 14, 1919

these streets through would be an exceedingly expensive operation, and could not be justified by the present industrial condition of the South End. If the future development of the South Bay permits a street to cross it, a connection should be provided between Old Colony Avenue at West Seventh Street and Malden Street or East Dedham Street. At present the two most direct roads to South Boston are separated from one another by a space of nearly a mile. Massachusetts Avenue is one of the widest and most useful thoroughfares of the district, having excellent gradients throughout. Dartmouth Street should also be made a main thoroughfare if possible by widening, by extending West Dedham Street to Old Colony Avenue, as described above, and by relieving the severe gradients of the bridge approaches at the Back Bay station.

The citizens of the South End feel that a more intimate connection with the Back Bay is desirable by an extension of the streets which now fail to cross the railway tracks. Unquestionably Arlington Street (see plan opposite page 218) should be extended, and perhaps Clarendon Street, but there are insufficient advantages in other possible extensions to warrant their cost. The cross streets of the South End which fail to connect with the cross streets of the Back Bay are only in part provided with foot bridges across the railway tracks. The residents of the South End require more of these foot connections, costing from $4,000 to $5,000 each.

A more crooked street cannot be imagined than Ivanhoe Street, which side steps 25 feet at every block. Bond Street, Ringold, Savoy and Perry streets are also crooked and narrow. To straighten or widen these streets would be nearly impossible on account of the cost, and certainly unnecessary, since they will never be needed to carry important traffic and at their present width will make serviceable frontages for small private dwellings and small tenement houses.

Mystic Street, opposite the Cathedral, should be widened. The southerly end of Bradford Street at its junction with Medford Court should also be widened, if for no other purpose than to permit the passage of fire apparatus in emergencies.

Stoneham.

See note on page 214; also maps opposite page 256.

Montvale Avenue, which connects Stoneham with Woburn, is one of the poorest cross-district roads in the vicinity of Boston and needs many changes to secure proper gradients. (See "Woburn.") Within the limits of Stoneham, Montvale Avenue should be connected with Elm Street by a widening and extension of Cottage Street. Summer Street should be widened and its junction with Franklin Street eased off to form a main line of travel from Winchester via Marble Street to Melrose. As the vacant land in the northern part of the town is developed, a street should be laid out from the end of North Street (at

George Street) to Mountain Avenue, Wakefield, to provide a cross-town line upon easy gradients.

The street system of Stoneham belongs in the class of the typical town, shown on plan opposite page 196, and consequently its main street is overburdened with traffic which cannot be distributed in side streets on account of their lack of continuity.

Swampscott.

See note on page 214; also maps opposite page 256.

During the last few years hosts of visitors have been attracted to Swampscott by the metropolitan seashore parkways, which approach the town from the south. The automobile has also greatly increased traffic on the old town streets, and has brought to a critical point the disabilities of these highroads. Owing to the abrupt character of the hills there are very few through highways, and those which exist need to be perfected in their connections as follows: —

Paradise Road, recently extended and improved, at its northern end needs better connection with New Ocean Street on the south, since it forms an agreeable and direct route to Marblehead and Salem and is bound to become an exceedingly important highroad. It needs connection with Essex Street by way of Elm Place under the Boston & Maine Railroad tracks. (See maps opposite page 256.) Such a line of communication would relieve the traffic of Essex Street from the sharp grades and eccentric angles of the approaches to the Essex Street bridge.

Columbia Avenue should be extended on its present line to the proposed development of Elm Place. (See improvements suggested for Columbia Avenue across the Lynn boundary, under "Lynn.")

The profile of New Ocean Street near Eastern Avenue is too steep and needs correction.

Humphrey Street furnishes the most popular communication between Lynn and the Marblehead district. It has a reasonably level profile but abounds in narrow constrictions and dangerous corners. Unquestionably, this is to be one of the great north shore highroads of the future, as it is of the present, and should have radical improvement. Its gradients at Ocean Street (in Lynn) are very bad, and it is exceedingly narrow near the end of Reddington Street.

Orient Street furnishes a seashore continuation or branch of Humphrey Street, and is also very narrow and crooked, particularly in its southern portions. This street is somewhat disappointing to sight-seers as it fails to follow the shore after it has passed the vicinity of the Ocean House. The construction of a shore road from the Ocean House northward to Phillips Beach would be hardly possible, however, on account of expense, since the shore is rugged and rocky and is occupied by summer residences. A solution of the pleasure and traffic needs of

Swampscott is suggested in the following scheme for a boulevard (see maps opposite page 256) : —

Widen Humphrey Street from the Soldiers' Monument to the vicinity of Orient Street and extend it thence to the southerly end of Phillips Beach, following this water front to Atlantic Avenue after passing Hotel Preston on the water side. This system of widenings and extensions should provide a boulevard of generous width furnishing a logical northern extension of the metropolitan parkways, and would carry this great system of public highways to the margin of the Metropolitan District. It would provide for traffic and electric cars as far as the bend in Humphreys Street in special reserved spaces, and would safeguard north shore pleasure vehicles from traffic annoyances. To create such a boulevard upon Orient Street would be difficult as the grades of that highway are undesirable and its line indirect, and property damage would be very great. The gradients and dangerous angles of Orient Street should be corrected, however, as desirable highway improvements.

The abrupt gradient of Humphrey Street between Atlantic Avenue and the Farms schoolhouse should be eased.

The system of curvilinear streets, embracing Banks, Grant, Farragut and Walker roads, represents an admirable achievement in road design. These streets are arranged upon a rugged hill to enjoy easy gradients while at the same time subdividing the land in convenient lots for suburban houses. This happy occupation of rough ground furnishes an agreeable contrast with the usual occupation of such irregular topography. A few thousand feet to the east of this development is Greenwood Street, a highway of such steepness that only the very lightest vehicles can pass over it. Its gradient is approximately 20 per cent.

Wakefield.

See note on page 214; also maps opposite page 256.

Wakefield has one of the finest main streets of the district. Its ample width and fine termination at Lake Quannapowitt, as well as the excellent buildings which border it, make Wakefield notable among towns. Unlike the typical town shown on plan opposite page 196, its main street is paralleled by numerous other through streets which make good connections. The cross streets of the town, however, are interrupted by the lake and the high ridge of land on the line of Pleasant Street. For this reason especial pains should be taken to perfect the Albion-Richardson-Water streets line, which is now interrupted by jogs and offsets, and which forms the natural connection between Stoneham and Saugus. A new street is needed from the vicinity of the junction of Travers and Bennett streets to Water Street. The town authorities should insist on such a line when the private property between Bennett and Water streets is cut up into lots.

Waltham.

See note on page 214; also maps opposite page 256.

Waltham belongs to that type of community (described on page 196) which has grown up upon a single main thoroughfare leading to Boston, and which has allowed its local streets paralleling this road to assume a mere rudimentary development. Although Waltham's Main Street is unusually ample in width, it cannot hope to handle for all time the east and west traffic of the city. To correct this situation Waltham Street should be widened and extended to River Street; Felton Street should be similarly widened and connected with the recently improved South Street; School Street should be connected at its western end through Columbus Street with Main Street, and at its eastern end through Church and Summer streets with Linden Street. Evidently these improvements cannot be carried out without great cost, but what alternative has the city in store for itself? It cannot develop properly with its present rudimentary system of east and west streets, and it cannot at the same time take care of the future through traffic of Weston, Wayland, Kendall Green and Concord, which now depend largely upon Main Street for their eastern connections.

The cross roads of the city also need connection. Lexington Street should be connected at School Street with both Elm Street and Moody Street (Common Street) by diagonal roads.

The southern part of Moody Street should be widened and made a proper channel for the traffic and business of the southern section of the city. There is also need of a new cross-district road to connect Farwell, Gove and Warren streets.

Waltham is to be congratulated upon the recently constructed Beaver Brook Road. This wide highway has, however, an unfortunately abrupt junction with Linden Street. Moreover, both its Linden and Quince Street connections are too narrow.

Forest and Beaver streets both need radical improvement in line, gradient and width.

Watertown.

See note on page 214; also maps opposite page 256.

Three of the main radial thoroughfares from Boston center in the heart of Watertown at its admirable new bridge, — North Beacon Street, Arsenal Street and Mt. Auburn Street. At this point of meeting five other lines — Galen Street, Watertown Street, California Street, Pleasant Street and Main Street — branch off like the sticks of a fan into Newton and toward Waltham. To this system of radial lines converging in Watertown the metropolitan park system will add another when the Charles River Reservation drives are completed. That Watertown Square under these conditions promises to become a center of con-

gestion there can be no reasonable doubt. An examination of the map of this center will show, however, that such an undesirable future can be prevented if certain by-pass streets are developed to permit a portion of the traffic of these great streets to pass around rather than through the square. For example, if Patten Street or Taylor Street were connected with Summer Street a portion of the east and west traffic of the north side of the river could be diverted from the square. A similar by-pass connection should be provided on the south side of the river, either by connecting Myrtle Street, Morse Street, Water Street and the Charles River Road, or by connecting a series of similar streets parallel to this line but nearer the Galen Street bridge.

The need of extending Summer and Fayette streets to join Highland Avenue and Warren Street is described at length on page 199. See also on that page an account of the needed extension of Howard Street through Waverley Street to Belmont. Pleasant Street should be widened to form an important main road to Waltham. Extend Dexter Avenue to Melendy Avenue. School Street should be developed as an ample cross-town road to Belmont, and Arlington and Grove streets should be developed as a cross-district line and connected with Market Street, Brighton, as shown upon the maps opposite page 256. A new bridge having an improved alignment over the Charles at the Arsenal would assist the creation of another cross-district line through Brighton via Brooks and Hobson streets, and would also assist the development of School Street, Watertown, as a logical continuation of that line.

Wellesley.

See note on page 214; also maps opposite page 256.

The streets north of the Boston & Albany Railroad tracks should be developed to form at least one trunk line of road upon the line of Linden Street (Wellesley Hills), Appleton Street (or Worcester Street) and Railroad Street (or Front Street).

The junction of Blossom and Cottage streets at Washington Street should be radically improved, to obviate the present inconvenient and dangerous jogs. These two streets form a link of growing importance between Weston and Dover. Cottage Street is only 33 feet wide and Blossom Street (south of the railroad tracks) varies from 30 to 36 feet wide.

Weston.

See note on page 214; also maps opposite page 256.

The general distribution of roads in this town is satisfactory, but the profiles of many of the main roads are exceedingly bad. In spite of this fact the town has lately resurfaced Newton Street between Wellesley Avenue and South Avenue without correcting its serious gradients. In the vicinity of the aqueduct this road needs complete relocation to secure reasonable gradients. To perpetuate the road upon its present

bad lines and grades is a short-sighted economy. Profile easements are also needed on Church Street near the Boston & Maine Railroad station, and near the Golf Club. Wellesley Avenue also needs improvement in gradient, especially through the Hundred Woods and in the vicinity of its junction with the Glen Road. There are few cross thoroughfares of the district as eccentric in line and gradient as Wellesley Avenue. Upon crossing the Wellesley line, however, this road (Blossom Street) is reasonably straight and is comparatively easy in its slopes. These roads are through lines and should be improved as soon as funds are available. Side roads like Summer and Highland streets are in a different class and do not require immediate improvement.

The town square of Weston is generally recognized to be one of the finest squares of the district. More land should be secured upon its borders, however, for future public buildings, and these structures, following the example of the new library, should be set back amply from the road in order to enlarge the extent of the square. Unless it is enlarged in this way it will lose character when it becomes closely hedged in with buildings. (See Medford Square, Fig. 34. Also see the enlargements made in Village Square, Brookline, and Watertown Square, opposite page 207.)

Westwood.

See note on page 214; also maps opposite page 256.

The town of Westwood, like the town of Dover, is well provided with convenient roads for its present stage of development. These roads generally follow the mid-slopes or upper valleys of the hills in order to give approach to hill farm land. In the future, other roads of more gentle inclination will be needed through the lowest valleys to provide more convenient lines of connection for through travel.

West Roxbury.[1]

See note on page 214; also maps opposite page 256.

The development of cross-town and cross-district thoroughfares by the improvement of South Huntington Avenue, Boylston Street, Seaver Street and Geneva Avenue is described under "Dorchester" and "Roxbury." Canterbury and Morton streets need similar development to form a traffic link between Talbot Avenue and Forest Hills. Hammond and South streets, Brookline, should form a cross-district line in connection with Church, South, Poplar, Seymour, Canterbury and Oakland streets. Lagrange Street, in connection with the pleasure roads of the Stony Brook Reservation, should form another cross line. Maple, Center and Beech streets (as far east as Washington Street) should be connected and extended to Hyde Park by a new valley road to the west of Poplar Street. The present Hyde Park connection with West Roxbury village via Poplar and Beech streets (or via Dale

[1] Including Jamaica Plain.

Street) could not be more ingeniously devised to secure bad gradients. The whole system of streets in the vicinity of Beech and Cornell streets does violence to all scientific principles of road placing. (See illustration of Aspinwall Hill, opposite page 198.)

Jamaica Plain occupies a maze of streets between the two radial thoroughfares, — Center Street and Washington Street, — and between the two cross-town thoroughfares, — Perkins Street and the Arborway. The district at large can, therefore, take little interest in the widening and connecting of Jamaica Plain's devious system of local streets, inasmuch as they are not needed for through routes. Jamaica Plain should take its highway system seriously in hand for improvement for its own local convenience.

Weymouth.

See note on page 214; also maps opposite page 256.

Few of the streets of Weymouth are less than 50 feet wide. Washington Street from Weymouth to Queen Anne Corner averages over 60 feet in width, while Main Street from Nash Corner in the direction of Abington is rarely less than 70 to 75 feet in width. Summer Street from Washington Square to Broad Street varies from 50 feet to 60 feet in width. Broad Street between Weymouth, Weymouth Center and East Weymouth varies from 40 to 50 feet, which is too narrow for the travel which passes over it.

At Columbian Square, South Weymouth, a community is growing up which promises to need in the near future radiating streets of more ample dimensions. Columbian Street varies from 40 to 50 feet in width, while Pond and Pleasant streets are from 50 to 52 feet in width. These two thoroughfares should be widened to place them in the same class with Union and Main streets, which are each over 60 feet in width. A community of almost equal vigor is growing up on Pleasant Street, and needs better communication by road with Nash Corner.

The abrupt hill upon which Granite and Prospect streets have been built, together with other streets arranged on a gridiron system, illustrates the unwisdom of constructing highways upon such prohibitive gradients. The usefulness of this hill to the town would have been greatly increased had streets been laid out upon it in such a manner as to conform to the contour of the ground, by which gradients of gentle character might have been secured. (See illustration of Aspinwall Hill and other eminences, page 198.)

Weymouth has a remarkably varied and picturesque water front, no large part of which has been reserved for public parks. Its large ponds are also undedicated to public service except as reservoirs. Liberal public takings should be made to embrace borders of the seashore and ponds. To avoid interference with the uses of the Fore River and Back River frontages for commercial purposes the seashore takings should be carefully chosen.

Town squares of ample size should be provided at Columbian Square, Lovell's and Thomas Corner. (See illustrations of Watertown and Brookline Square enlargements opposite page 207.)

Winchester.

See note on page 214; also maps opposite page 256.

Forest Street, Winchester, which with Marble and Franklin streets, Stoneham, forms a cross-district road of much importance, deserves better connection with Cross Street. That is to say, the narrow and roundabout portion of Forest Street between Washington Street and the Winchester Highlands station should be widened and straightened, Forest and Marble streets should be improved in profile, and Cross Street should be widened.

The northern end of Highland Avenue should be relocated to secure a proper gradient of approach to the entire upland portion of the town from Marble Street. A branch road should be built to connect Highland Avenue with the border road of the Fells Reservation near South Dam. Judkins Pond (Fig. 20, opposite page 197) should be either filled in or permanently reserved. At present it serves to handicap the development of all the streets upon its borders.

Winthrop.

See note on page 214; also maps opposite page 256.

Winthrop, including its southerly peninsula, Point Shirley, is almost detached from the mainland by Belle Isle Inlet. The town is in effect an island connected with the mainland by three causeways, — the Saratoga Street bridge, the bridge of the narrow-gauge railroad and the road to Winthrop (Revere Street).

As a whole, the street system of the town is an admirable one. The majority of the roads are exceedingly well placed and have very gentle gradients. The roads upon Winthrop Greathead, however, are dangerously steep, and those upon the northwesterly end of Winthrop Highlands are so steep that vehicles of any kind rarely risk the danger of passing over them. Upon the other hand, that portion of Winthrop known as Court Park, the contours of which have considerable ruggedness, has a road system admirably adapted to the contour of the ground, none of the streets being objectionably steep.

The streets of the northwesterly end of Winthrop Highlands should be relocated before house building operations are begun, to provide gradients passable for ordinary vehicles.

The connections with Revere by way of the easterly side of Beachmont are unsatisfactory on account of bad gradients. Revere Street with its 10 per cent. gradient opposite Fort Banks does not afford a satisfactory approach to the middle of the town. Evidently a short cut over the marshes, passing the westerly side of Fort Banks, through Winthrop

Street to Magee's Corner, would furnish a more satisfactory and considerably more direct route.

At the southerly end of the town, in the vicinity of Cottage Park, there are many streets terminating at the water without proper water front connections, — Orlando Avenue, Woodside Avenue, Plummer Avenue, Sunnyside Avenue and Pico Avenue. Evidently they should be connected by an extension of Johnson Avenue.

The town is admirably provided with parks; Ingleside Park together with the Winthrop Shore Reservation seem adequate for all future recreative needs. The lack of communication between the Winthrop Shore Reservation and the Revere Beach Reservation is, however, noteworthy. When this connection is established a more fitting termination for the great series of shore drives will be needed than that which is afforded by the little circular carriage turn at Beacon Street. An extension of the water-front reservations and drives to Point Shirley would provide a satisfactory terminus and an admirable climax to the succession of seashore reservations.

River Road should be extended to Oakland Street. The position of Hale Street on the easterly side of Point Shirley should be shifted to provide proper ascent to the high ground on easy gradients.

Ingleside Park is unprovided with a border road between Beale Street and Palmyra Street. The vacant land between those streets should be secured for the park, or a border road provided, both to protect the park and private property against trespass. Similar border roads are needed north of the schoolhouses in the vicinity of the Baptist Church and behind the library and the proposed site for a town hall. In no other way can future buildings on the adjacent private property be made to face upon these public grounds rather than back upon them. (See figs. opposite page 197.)

The group of public buildings in progress of development in the vicinity of Columbia Square promises to be admirable. A large share of the success of this group depends upon keeping free from buildings the open space in front of the library. This open space should never be allowed to become a building site.

Magee's Corner, the meeting point of five important streets, deserves an open square of greater size to give proper character and convenience to this important junction of main roads. (See the enlargements of Brookline village and Watertown squares, opposite page 207.)

Woburn.

See note on page 214; also maps opposite page 256.

Montvale Avenue, which connects Woburn with Stoneham, is one of the steepest cross-district roads in the vicinity of Boston. Its abrupt slopes cannot be corrected by mere grading operations but must be effected by partial relocation, notably east of Vernon Street. Salem

and Pine streets, on account of their easy gradients, will always form an important line of connection with Stoneham, and they should, therefore, be improved in line and in width (Pine Street is only 36 feet wide and carries electric car tracks).

Main Street is very narrow and for this reason the side streets which approximately parallel it should be developed to form other continuous through streets. High Street, for instance, should be connected by easy curves instead of by its present sharp corners with Prospect Street. Warren Street should be extended in a northerly direction to Winn Street, and Beacon Street should be extended along the easterly borders of Horn Pond to Arlington Road to afford other more continuous through lines of highway upon good gradients. The proposition to connect Horn Pond via Arlington Road, and Wedge Pond, Winchester (see Metropolitan park report for 1901, page 59), would connect Woburn admirably with the Fells Reservation and the Mystic Valley, and would assist Winchester to solve the sanitary problems of the Wedge Pond valley. To build a parkway between Woburn and Winchester via Winter Pond would add a useful road to Woburn, but it would not be as serviceable as a connecting parkway link.

Now is the time for Woburn to decide whether Park, Center and Johnson streets are to be perpetuated in the midst of the business section of the city at their present narrow width, crooked line and bad gradients, and allowed to become a species of alley way, or whether these streets are to be perfected by widening and by joining to become a fine street, which would relieve Main Street of congestion by taking a portion of its constantly increasing traffic.

Washington Street should be extended upon its own line in the vicinity of the old canal near Mill Street, to avoid the present circuitous detour through a portion of Pine Street. The gradient of Lexington Street should be improved near Burlington Street by making a detour of the knoll upon its southern side. Winn Street and Main Street should be widened. Lexington Street should be relocated to secure proper gradients. It can never be made suitable for teaming upon its present location, and the city of Woburn cannot afford to spend its money in attempting to cut down hills and fill in valleys which by their contours oppose the passage of the road when there is near at hand a location which naturally favors the passage of the road.

The public recreation grounds of Woburn are not properly provided with border roads. Forest Park and the Library Park (see plan opposite page 197) are both unprovided with protective streets of this nature. To allow a proper development of Library Park and of the private property adjoining it border roads should be planned at once.

Woburn's square is one of the finest open spaces of this character in the district. (See Fig. 24, opposite page 206.)

SEE ACCOMPANYING MAP FOR CIRCUMFERENTIAL ROADS.

COMMONWEALTH OF MASSACHUSETTS

METROPOLITAN
IMPROVEMENTS COMMISSION

MAP OF THE

EXISTING AND PROPOSED RADIAL THOROUGHFARES OF THE DISTRICT AND THEIR CONNECTIONS

SCALE OF MILES

0 1 2 3 4 5

ARTHUR A. SHURTLEFF LANDSCAPE ARCHITECT 22 CONGRESS STREET BOSTON

LEGEND

RADIAL ROADS 60 FEET WIDE OR MORE
RADIAL ROADS LESS THAN 60 FEET WIDE
NEEDED RADIAL ROADS AND CONNECTIONS

[TOPOGRAPHICAL SHEETS SECURED BY COURTESY OF THE U.S. GEOLOGICAL SURVEY]

Contour Interval 20 Feet.
Datum is mean sea level.

Scale 1/62500
1 Mile

HELIOTYPE CO., BOSTON.

SEE ACCOMPANYING MAP FOR RADIAL ROADS.

COMMONWEALTH OF MASSACHUSETTS

METROPOLITAN
IMPROVEMENTS COMMISSION

MAP OF THE

EXISTING AND PROPOSED CIRCUMFERENTIAL THOROUGHFARES OF THE DISTRICT AND THEIR CONNECTIONS

SCALE OF MILES

0 1 2 3 4 5

ARTHUR A. SHURTLEFF LANDSCAPE ARCHITECT 22 CONGRESS STREET BOSTON

LEGEND

- CIRCUMFERENTIAL ROADS 60 FEET WIDE OR MORE
- CIRCUMFERENTIAL ROADS LESS THAN 60 FEET WIDE
- NEEDED CIRCUMFERENTIAL ROADS AND CONNECTIONS

[TOPOGRAPHICAL SHEETS SECURED BY COURTESY OF THE U.S. GEOLOGICAL SURVEY]

ATLANTIC OCEAN

BOSTON HARBOR

MASSACHUSETTS BAY

QUINCY BAY

HINGHAM BAY

NAHANT BAY

HELIOTYPE CO., BOSTON

The Powers of the Authorities in Control of the Highways of the District.

Each of the 39 cities and towns of the district appoints officials of its own to take charge of its highways, with the exception of those which are controlled permanently or temporarily by the Massachusetts Highway Commission, the Metropolitan Park Commission and the county commissioners.

In a few municipalities of the district, including Boston, boards of survey have been established with powers which enable them partially to control the layout of streets designed by private individuals, and to prepare schemes for the extension of the highways of the town. The powers of these boards are necessarily limited because the municipalities are not financially able to take land at once by eminent domain, either for needed future roads or to correct the immediate faults of local land schemes. Under these circumstances little more can be done by these authorities, without trespassing upon the personal rights of individuals, than to map the needed improvements and to notify abutters that only by honoring the proposed road lines may they enjoy water, sewer and gas privileges from the town. Generally speaking, the local engineering departments are limited in the field of their activities and lack sufficient authority properly to safeguard the convenient extension of the highways. So active is the private landowner to subdivide property and after selling it to bring its streets under public care that municipalities have no money left for the proper improvement of old streets or for the extension of their main highway systems.

The Massachusetts Highway Commission is empowered by the Legislature, upon the petition of towns in any part of the State, to make improvements in the surface width or line of roads, and afterwards to maintain these thoroughfares as State roads independent of the town. Seventy-five per cent. of the cost of this work is paid by the State and twenty-five per cent. by the county. The activities of this commission are chiefly directed to the improvement of highways in sparsely settled regions and have not been exercised except upon rare occasions within the Metropolitan District. Upon petition this commission also acts as agent to execute highway improvements for and at the expense of individual municipalities, but without afterward holding control of the improved way or being responsible for it.

The county commissioners have powers somewhat similar to the highway commission, with the exception that their field of action is limited to the county, and they do not retain permanent control of the roads they improve. The cost of construction of works undertaken by these commissioners is sometimes borne in part by the county, but more frequently by the town in which the improvement is made.

The Metropolitan Park Commission is empowered by the Legislature to build roads primarily for pleasure and recreative purposes in any part of the Metropolitan District. They also maintain and police these roads. One-half the cost of construction and maintenance is assessed by apportionments upon the several cities and towns comprising the Metropolitan Parks District and the other half upon the State.

The park commissioners of Boston and of the several cities and towns of the district have control of the roads in their own municipal parks and parkways only or in the immediate vicinity of such public recreation spaces.

The Boston Transit Commission is appointed by the Governor of Massachusetts and the mayor of Boston. The duties of this commission are largely confined to the design and construction of subways in the city of Boston. The commission has studied the congestion problems of the city, however, and has made suggestions for their solution.

A New Civic Center for Boston.

BY ROBERT S. PEABODY AND ARTHUR A. SHURTLEFF.

An open space or square before a public building is of service to a community not alone because it lends dignity to an important edifice and distinguishes it from mere private structures, but because such a square ensures for it perpetual light and air and allows vehicles and persons upon foot to approach it with convenience and without confusion. The importance of such a convenient and dignified setting is immeasurably increased when several public edifices are grouped about the margins of such an open space. A nobility of treatment and an economy of administration are thereby secured which would be impossible to the same buildings if scattered. The existence of such a group of related public buildings stimulates civic pride, tends to raise the standard of all public works and lends prestige of a desirable kind to the community.

It is not necessary that all the buildings of such a group be built at once, but a good project once determined upon can be developed as opportunity offers.

Any visitor to Europe sees many such centers. They are generally the product of a slow growth. In Paris, for instance, the Palace of Justice, the Hospital, the Cathedral of Notre Dame form one center; the palaces of the Louvre and the Tuileries form another; and still another example may be found where the University and the Pantheon and the Library of St. Genevieve are grouped with other educational and ecclesiastical buildings. Brussels possesses in its town hall and other buildings which front on the Grande Place a group so valued by its citizens that subsidies are given to abutters to keep their ancient houses in repair, and where necessary the city purchases the building and makes the repairs itself. Vienna has perhaps the

most complete scheme of monumental sites of any European city in its Ringstrasse, on or near which are to be found most of the prominent city buildings.

Our people were unconscious of what might be done in our own cities until the ephemeral splendors of the Exposition of Chicago showed hundreds of thousands how grand could be the effect of buildings arranged in a stately manner. We suddenly became aware that it was worth while, both for enjoyment and for profit, to invest in civic beauty. We saw that the advantages to be gained by grouping public edifices are not alone for the eye but that they tend to convenience and to simplicity of administration and maintenance. Since that time numerous cities in the United States have been formulating plans for civic centers, and with greater or less success carrying them to fruition. The popular demand is loud and insistent, and as the successful projects of Washington and Cleveland assume shape it will be even louder and more insistent.

Although the creation of a civic center of this kind may seem to-day too great an undertaking for Boston, it should be remembered that similar important undertakings have been already carried to successful issue by united public effort here in Boston itself. The creation of the South terminal station, the filling of the Back Bay and the consequent extension of the city to the west, and the building of Commonwealth Avenue and the park system were all large public enterprises. So was the building of Quincy Market and of the streets and blocks which formed what was a very orderly and well-arranged neighborhood until unfortunate changes were made in the surrounding blocks to meet the taste or needs of individual owners. Of this enterprise it is said that "a granite market house, two stories high, 535 feet long, covering 27,000 feet of land, was erected at a cost of $150,000. Six new streets were opened and a seventh greatly enlarged, including 167,000 feet of land, and flats, docks and wharf rights obtained to the extent of 142,000 square feet." All this was accomplished in the center of a populous city, not only without any tax, debt or burden upon its pecuniary resources, but with large permanent additions to its real and productive property.

The creation of a civic center surrounded by public build-

ings would add value to surrounding property in most parts of Boston. Massachusetts permits the assessment for betterment in certain cases on surrounding property that has been thus benefited by public improvements. Lately a law was passed permitting in a very restricted way the taking of entire properties of which a portion only is requisite for the improvement, the remainder to be disposed of to neighbors or others. Hitherto, however, Massachusetts has uniformly kept free from appropriating by eminent domain more land than is needed for an undertaking, although it might be desired with a view to its sale and the public profit after the completion of public works has enhanced values. It has been held here that this is an encroachment on private rights. There are, however, those who think that the formation of a civic center should be preceded by a readjustment of the laws, so that large areas could be taken and the increase in values accrue to the city. Whatever the merits of this point of view it certainly seems radical to many and would cause delay and discussion. Hence it seems better first to decide what locality offers the best site, as these unusual measures may not prove necessary.

There are many sites in Boston where a civic center might be formed about open spaces, perhaps with a city hall as the chief building, or consisting of a group of other public edifices either educational, governmental, financial or charitable in character. The sites most considered for such a center may be reviewed briefly as follows: —

1. The property owned by the city contiguous to the present city hall and now occupied by the old court house, the old registry of deeds and the police station, might be covered with new buildings, and these might be extended, as suggested by the recent report made by Mr. J. Randolph Coolidge to the Financial Commission, to include Niles Block. This plan has been carefully considered with regard to the city's financial condition and the present channels of business, and has many admirable features, but it does not present an opportunity to create an ample civic center about which other public edifices might be grouped without crowding a neighborhood already congested.

2. The Providence Railroad property has been suggested

many times as a good site for a group of public buildings, and the availability of this vacant tract for building purposes near the heart of the city evidently recommends it. If a system of streets were laid out upon this territory as shown upon the plan opposite page 218 at least two schemes for building groups might be created.

Plan No. 3*b* shows such a civic center on rather spacious lines, and Plan No. 3*a* shows it in a more modest form. The sale of the existing city hall and the profit accruing from the sale of land taken but not finally needed would go far towards paying for this new site and some of its buildings. It will be observed that the center created by either of these plans lies at the intersection of Arlington Street extended and the prolongation of St. James Avenue (widened). It is, therefore, well connected with Copley Square, the Back Bay station, Boylston Street, Park Square and Castle Square, and should be convenient of access from all parts of the city, although retired from the traffic of Boylston Street and Columbus Avenue.

It may be urged as an objection that it creates a new square or center in a region already supplied with open spaces in the Common, Public Garden, Park Square and Copley Square.

3. The following plan, also relating to the Providence Railroad property, has been urged by some public-spirited citizens, but before it could be carried out legislation as noted above would be necessary to permit the taking by eminent domain of more property than the public buildings alone demand. The purchase of the Providence station property is suggested, together with the taking and purchase of so much of the blocks on the south side of Boylston Street between Park Square and Berkeley Street and on the north side of Boylston Street between Arlington and Berkeley streets as may seem worth while. Those who urge this would have the purchase made by a holding company formed of subscribers to bonds of a small par value, to whom the city should guarantee the erection of city buildings on lots assigned in a new plan of this whole property. The presence of these city buildings and an advantageous arrangement of streets would extend the business district and so ad-

vance the value of the remaining property that the holders would be reimbursed. Plan No. 4 on the key plan indicates roughly how city buildings might be very advantageously placed were this ambitious project carried out.

4. Castle Square has been suggested as a central site for a civic center and the undeveloped region between it and Columbus Avenue offers a fine chance for extending and widening Arlington Street in a very monumental way to this site. The cost of executing this scheme and the problematical development of property in the vicinity of Castle Square have thus far stood as an obstacle to its realization.

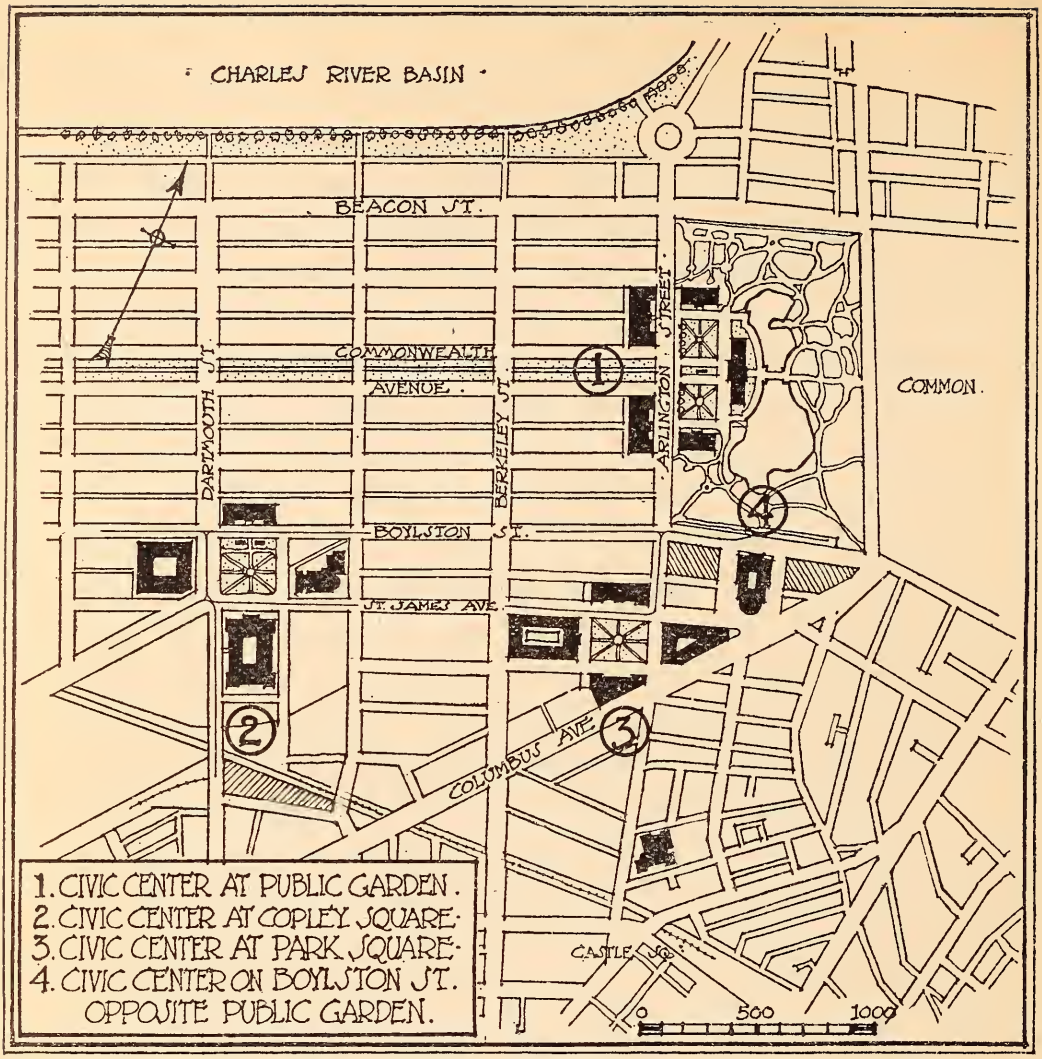
5. An island in Charles River, approached by short bridges from Boston and Cambridge, has been suggested as the suitable site for a group of public buildings. Such a center, while it would enjoy a singularly picturesque situation, is open to the objection that it would be isolated in large measure from the city as a whole, and would not be convenient for buildings which are resorted to in daily routine work by a large part of the community.

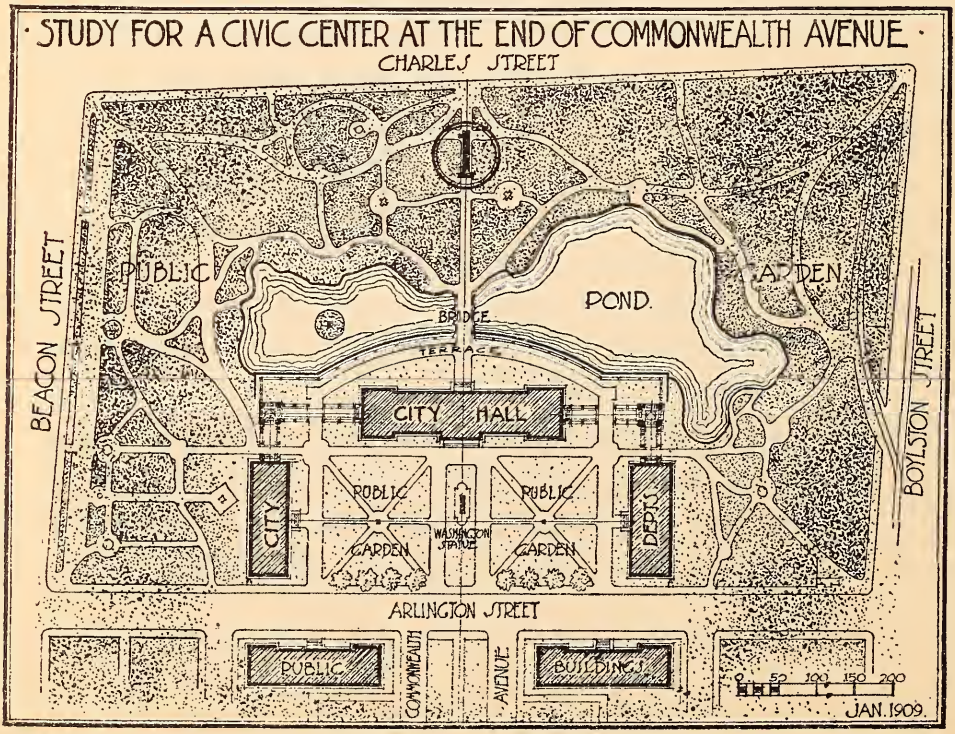
6. Some years ago two studies were carried to an advanced stage by the then city architect, Mr. Wheelwright, one for a city hall on Beacon Street opposite the Garden and near the Charles River basin, and one for a city hall between the State House and the court house. This latter project especially would have resulted in a very magnificent civic center, formed by the State House, court house and city hall, for which the top of Beacon Hill would have been a wonderful site. Because it offered such a remarkable opportunity for monumental effect it is to be regretted that it was not carried out, but the presence of large costly buildings upon this land now renders it most improbable that this project can ever be considered.

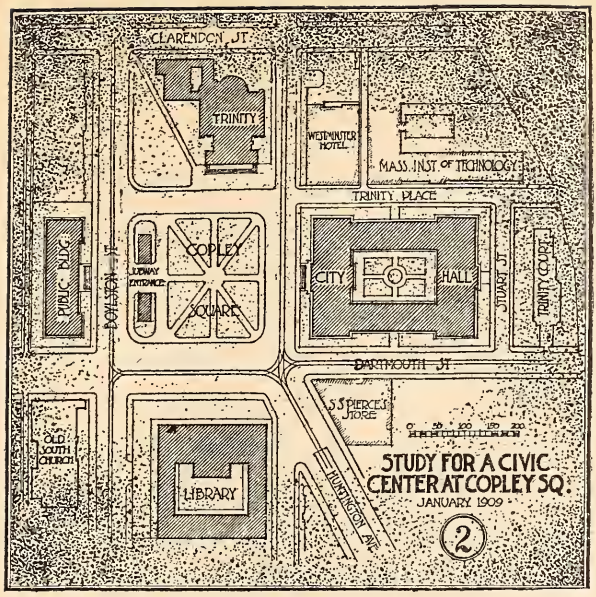
7. By the Acts of 1859 all future buildings were finally excluded from the Public Garden except a city hall and buildings for horticultural purposes. In view of the existence of that provision it is proper to consider this site and study its advantages and disadvantages. Commonwealth Avenue, which is so fine a thoroughfare in itself, ends towards the east abruptly at an iron fence, behind which somewhat remotely stands the eques-

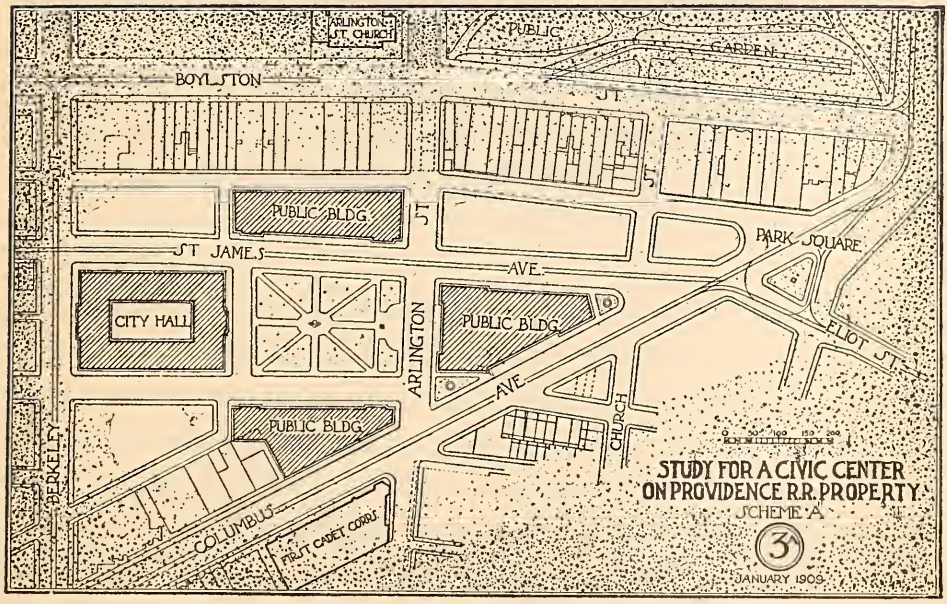
trian statue of Washington. A stately executive city building might be placed between the statue and the bridge over the lake. Wings on either side of this structure might contain, one the engineering offices and the other the financial offices of the city. In the remote future the sites on Arlington Street might also be occupied by public buildings. A very noble arrangement of buildings would thus form the termination of a very fine avenue, and have ample light on every side and easy access to all parts of the city. All this could probably be obtained at little or no cost, as the sale of the present city hall would go far to cover all needed outlay. This scheme is evidently open to the objection that it brings public buildings into a distinctly residential neighborhood and that it takes for building purposes land which has long been used for a park and which probably could not be devoted to the use for which the act of 1859 provided without strong public protest. A sketch for such a civic center is shown on Plan No. 2 (opposite this page).

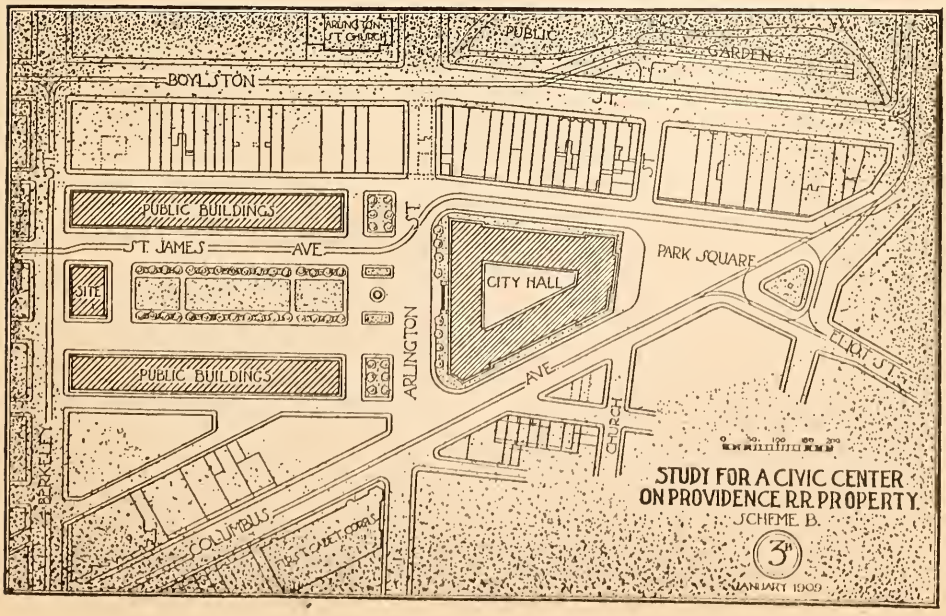
8. We have already one very notable civic center — inadequate, it is true, but well begun. Trinity Church and the Public Library form two sides of an unfinished group. The Art Museum is about to move away. If a site for a city hall is to be bought, this square might be finished and be made very fine and complete by placing a city hall on the museum site and a related public building on the north side of the square. The situation is geographically central and convenient to all parts of the city. It is exceptionally well served by steam and electric roads. City buildings here would injure no property rights but would probably enhance values. They would complete a fine group already started with structures of the highest class. An altogether satisfactory civic center would be the result. By the extension of St. James Avenue through to Arlington Street extended, or to Park Square, the Huntington Avenue traffic would reach the business city without crowding Boylston Street, surface cars can loop from Huntington Avenue to the subway or to the North station without injury to any, and the squaring up of the irregular Copley Square will be possible. A civic center planned on these lines is indicated in Plan No. 2.


CHARLES RIVER BASIN
BEACON ST.
COMMONWEALTH AVENUE
DARTMOUTH ST.
BERKELEY ST.
ARLINGTON STREET
COMMON.
BOYLSTON ST.
ST. JAMES AVE.
COLUMBUS AVE.
CASTLE SQ.
1. CIVIC CENTER AT PUBLIC GARDEN.
2. CIVIC CENTER AT COPLEY SQUARE.
3. CIVIC CENTER AT PARK SQUARE.
4. CIVIC CENTER ON BOYLSTON ST. OPPOSITE PUBLIC GARDEN.
0 500 1000


STUDY FOR A CIVIC CENTER AT THE END OF COMMONWEALTH AVENUE.
CHARLES STREET
BEACON STREET
PUBLIC
GARDEN
POND.
BRIDGE
TERRACE
CITY HALL
CITY
PUBLIC
GARDEN
WASHINGTON STATUE
PUBLIC
GARDEN
DEPT.
BOYLSTON STREET
ARLINGTON STREET
PUBLIC
COMMONWEALTH AVENUE
BUILDING
0 50 100 150 200
JAN. 1909.


CLARENDON ST.
TRINITY
WESTMINSTER HOTEL
MASS. INST. OF TECHNOLOGY
TRINITY PLACE
PUBLIC BLDG.
COPLEY SQUARE
SUBWAY ENTRANCE
BOYLSTON ST.
CITY HALL
STUART ST.
TRINITY COURT
DARTMOUTH ST.
S.S. PIERCE'S STORE
OLD SOUTH CHURCH
LIBRARY
HUNTINGTON AVE.
STUDY FOR A CIVIC CENTER AT COPLEY SQ.
JANUARY 1909
2


ARLINGTON ST. CHURCH
PUBLIC GARDEN
BOYLSTON ST.
PUBLIC BLDG.
ST. JAMES AVE.
PARK SQUARE
CITY HALL
ARLINGTON ST.
PUBLIC BLDG.
ELIOT ST.
CHURCH
BERKELEY ST.
PUBLIC BLDG.
COLUMBUS AVE.
FIRST CADET CORPS
STUDY FOR A CIVIC CENTER ON PROVIDENCE R.R. PROPERTY.
SCHEME A
3
JANUARY 1909


ARLINGTON ST. CHURCH
PUBLIC GARDEN
BOYLSTON ST.
PUBLIC BUILDINGS
ST. JAMES AVE.
SITE
CITY HALL
PARK SQUARE
ARLINGTON ST.
ELIOT ST.
PUBLIC BUILDINGS
AVE.
CHURCH
BERKELEY ST.
COLUMBUS AVE.
FIRST CADET CORPS
STUDY FOR A CIVIC CENTER ON PROVIDENCE R.R. PROPERTY.
SCHEME B.
3
JANUARY 1909

Conclusion.

A review of these sites for a group of public buildings points to that on the Public Garden at the end of Commonwealth Avenue as the cheapest as well as one where great results could be obtained. Although this purpose was in mind in 1859, when the Garden obtained its present form, public opinion would probably forbid city buildings in this residential neighborhood or to taking land now used for a park.

If such objections prevail as to this use of a portion of the Garden, the finest group on a purchased lot that is already occupied by buildings could be obtained at Copley Square, because on two sides of the square there already exist permanent public buildings of great distinction, that on a third side is destined to be soon replaced, and on the fourth side the buildings are not of excessive value. Besides, this site is convenient to transit facilities, and though a little removed from the old city is yet in fact very central and constantly growing more so.

If land is to be purchased that has no buildings on it whatever, that offered by the Providence Railroad property is well suited to the purposes of a civic group, but it is essential here that much land be taken to give a square or very liberal space around the buildings. This vacant tract adjoins the most rapidly growing portion of the city, is bounded by busy thoroughfares and is ready of access from all quarters.

March 10, 1909.

FINANCES.

BY HENRY B. DAY.

TABLE A. — *Statement of the Financial Condition*

		1. Population Census of 1905.	2. Assessed Valuation. 1908.	3. Net Local Funded Debt (including Water Debt).	4. Proportion of Net Metropolitan Debt.[1]	5. Proportion of Net State Debt (Other than the Metropolitan Debt).[2]
1	Arlington,	9,672	$11,105,046	$564,550 58	$417,385 94	$42,825
2	Belmont,	4,361	6,078,650	232,646 16	205,362 29	23,458
3	Boston,	593,598	1,327,662,338	74,099,388 90	36,803,489 98	5,122,075
4	Braintree,	6,877	5,799,321	188,755 48	24,140 60	21,400
5	Brookline,	23,424	100,766,800	1,381,330 00	2,284,342 45	388,036
6	Cambridge,	97,426	105,801,070	8,277,899 41	1,833,113 70	398,438
7	Canton,	4,702	3,990,140	99,000 00	19,260 60	15,386
8	Chelsea,	37,289	20,872,400	1,243,847 00	1,312,050 69	80,429
9	Cohasset,	2,759	7,043,823	86,429 84	2,196 00	26,810
10	Dedham,	7,774	12,613,550	286,000 00	247,839 03	48,504
11	Dover,	656	1,402,132	–	5,238 80	5,406
12	Everett,	29,111	24,832,800	1,213,306 48	1,053,111 48	95,777
13	Hingham,	5,059	5,769,551	34,672 20	22,841 60	22,224
14	Hull,	1,703	5,177,250	94,288 40	20,003 00	19,931
15	Hyde Park,	14,492	14,019,675	262,500 00	299,834 02	53,972
16	Lexington,	4,530	6,884,670	260,249 99	149,003 00	26,633
17	Lynn,	77,025	68,399,271	3,199,881 72	258,099 90	263,688
18	Malden,	37,990	33,601,500	1,337,615 95	1,150,337 87	129,639
19	Medford,	19,638	22,859,950	667,572 15	1,021,653 36	88,190
20	Melrose,	12,962	15,972,960	406,763 83	689,927 75	61,733
21	Milton,	7,051	23,864,970	317,000 00	857,072 03	92,070
22	Nahant,	1,152	5,934,687	–	110,210 12	22,929
23	Needham,	4,284	5,672,972	320,500 00	19,529 90	21,871
24	Newton,	36,694	68,575,385	3,894,436 89	1,687,337 44	264,570
25	Quincy,	28,067	28,282,759	1,839,060 00	1,296,384 15	108,003
26	Revere,	12,647	15,055,550	940,097 00	630,572 16	51,150
27	Saugus,	6,252	5,134,819	180,850 00	19,452 40	19,807
28	Somerville,	69,188	63,158,400	1,466,500 00	2,611,217 34	243,404
29	Stoneham,	6,320	5,027,334	219,000 00	230,700 33	19,402
30	Swampscott,	5,141	9,992,655	447,769 55	49,657 70	38,451
31	Wakefield,	10,266	8,603,573	690,600 00	138,141 20	33,336
32	Waltham,	26,282	24,910,666	732,838 57	520,345 90	95,774
33	Watertown,	11,202	13,888,215	757,025 00	522,265 69	53,619
34	Wellesley,	6,185	13,673,875	309,742 98	54,698 70	52,738
35	Weston,	1,834	6,800,500	10,000 00	31,899 90	26,104
36	Westwood,	1,112	2,316,676	–	10,202 30	8,925
37	Weymouth,	11,585	7,668,715	332,382 12	32,450 50	29,455
38	Winchester,	8,236	11,516,400	509,000 00	221,699 60	44,448
39	Winthrop,	7,034	10,757,665	485,548 00	375,094 18	41,449
40	Woburn,	14,401	11,094,504	416,257 03	187,434 40	42,684
41	Charles River basin loan.[4]	–	–	–	2,660,469 76	–
	Totals,	1,265,981	$2,142,583,217	$107,805,305 23	$60,192,223 14	$8,244,743

[1] See Table B.

[2] Based on assessed valuation of 1908.

FINANCES.

BY HENRY B. DAY.

of the Metropolitan District, Dec. 31, 1908.

6. Proportion of Net County Debt.[2]	7. Total Net Debt (Summary of Columns 3, 4, 5, and 6).	8. Percentage of Net Metropolitan Debt to Total Net Debt (Ratio of Column 4 to Column 7).	9. Total Net Debt per Capita.	10. Percentage of Total Net Debt to Assessed Valuation.	11. Payments, 1908, Interest, Sinking Funds and Serial Issues, on Total Debt; exclusive of Charges on Water Issues (paid by Water Receipts).[3]	12. Percentage of Annual Payments (Column 11) to Annual Expenses of the Municipalities.[3]	13. Tax Rate per $1,000. 1908.	
$10,235	$1,034,996 52	40.32	$107 01	9.32	$41,128 15	15.18	$19 30	1
5,595	467,061 45	43.98	107 10	7.68	41,143 02	28.77	20 00	2
–	116,024,953 88	31.72	195 47	8.74	6,164,388 85	23.26	16 50	3
5,392	239,688 08	10.07	34 85	4.13	21,056 60	14.42	21 20	4
94,627	4,148,335 45	55.07	177 09	4.11	371,476 90	21.93	.11 50	5
97,405	10,606,856 11	17.29	108 87	10.02	580,215 04	23.35	20 10	6
3,713	137,359 60	14.08	29 21	3.44	5,257 45	6.18	19 50	7
–	2,636,326 69	49.77	70 69	12.63	221,013 25	25.70	21 40	8
6,551	121,986 84	1.80	44 21	1.73	11,143 32	10.13	12 00	9
11,722	594,065 03	41.73	76 42	4.71	53,289 36	20.65	16 80	10
1,296	11,940 80	43.87	18 20	.85	750 15	2.08	9 80	11
22,885	2,385,079 96	44.16	81 94	9.60	144,716 95	20.44	19 00	12
6,253	85,990 80	26.56	17 00	1.49	10,820 15	9.09	14 60	13
5,122	139,344 40	14.35	81 82	2.69	28,495 25	29.07	19 00	14
12,952	629,258 02	47.69	43 42	4.49	45,876 00	13.94	17 20	15
6,325	442,210 99	31.43	97 62	6.42	16,750 41	10.60	20 00	16
206,870	3,928,539 62	6.57	51 00	5.74	343,524 60	22.90	20 00	17
30,935	2,648,527 82	43.43	69 72	7.88	182,170 87	20.24	19 20	18
21,045	1,798,460 51	56.81	91 58	7.87	154,716 57	25.79	20 80	19
14,720	1,173,144 58	58.82	90 51	7.34	59,695 42	17.06	18 50	20
22,188	1,288,330 03	66.54	182 72	5.40	62,797 02	16.93	13 20	21
17,952	151,091 12	72.99	131 16	2.54	5,199 92	7.22	11 00	22
5,271	367,171 90	5.32	85 71	6.47	14,020 79	11.68	17 00	23
63,135	5,909,479 33	28.56	161 05	8.62	397,543 84	24.85	18 20	24
26,355	3,269,802 15	39.64	116 50	11.56	210,001 14	29.25	20 50	25
–	1,621,819 16	38.88	128 24	10.77	81,037 35	20.93	22 00	26
15,523	235,632 40	8.25	37 69	4.59	20,413 27	14.58	22 80	27
58,132	4,379,253 34	59.63	63 29	6.93	284,638 34	19.31	18 40	28
4,629	473,731 33	48.67	74 96	9.42	13,716 85	10.08	20 50	29
30,202	566,080 25	8.78	110 11	5.66	35,815 32	17.91	16 50	30
7,935	870,012 20	15.88	84 74	10.11	37,354 46	18.68	21 95	31
22,942	1,371,900 47	37.93	52 19	5.51	101,814 71	18.61	18 00	32
11,845	1,344,754 69	38.83	120 05	9.68	52,300 32	17.79	19 35	33
12,592	429,771 68	12.72	69 49	3.14	34,675 78	16.51	12 00	34
6,267	74,270 90	42.95	40 49	1.09	4,306 63	3.71	11 40	35
2,154	21,281 30	47.94	19 14	.92	1,367 89	4.56	11 40	36
7,128	401,415 62	8.08	34 65	5.23	19,871 48	9.28	21 50	37
10,695	785,842 60	28.21	95 42	6.82	48,622 83	19.85	17 40	38
–	902,091 18	41.58	128 25	8.39	46,938 24	21.43	18 20	39
10,235	656,610 43	28.55	45 59	5.92	62,929 08	22.16	19 80	40
–	2,660,469 76	–	–	–	133,000 00	–	–	41
$898,823	$177,141,094 37	33.98	$139 92	8.27	$10,165,993 57	22.57	–	

[3] While substantially correct, some cases approximate.

[4] Not yet apportioned.

TABLE B. — *Distribution of Metropolitan Debt and Charges, Dec. 31, 1908.*

TOWNS AND CITIES.	1. Proportion of Net Metropolitan Water Debt.	2. Proportion of Net Metropolitan Park Debt.	3. Proportion of Net Metropolitan Boulevard Debt.	4. Proportion of Net Metropolitan Nantasket Debt.	5. Proportion of Net Metropolitan Sewer Debt (North System).	6. Proportion of Net Metropolitan Sewer Debt (South System).	7. Payments for 1908 Interest and Sinking Funds, Account of All Metropolitan Issues.	8. Payments for 1908 for Maintenance Account of Metropolitan District.	9. Total Payments, 1908, on Account of Metropolitan District, excluding Charles River Basin (Summary of Columns 7 and 8).
Arlington,	$247,797 24	$35,964 50	$8,089 20	$3,006 00	$122,529 00	–	$22,711 86	$8,410 55	$31,122 41
Belmont,	102,283 29	21,879 00	4,922 00	1,830 00	74,448 00	–	11,028 32	4,084 28	15,112 60
Boston,	26,786,737 00	4,449,945 50	999,722 40	372,054 00	850,465 00	$3,344,566 08	2,046,611 69	631,088 73	2,677,700 42
Braintree,	–	18,447 00	4,151 60	1,542 00	–	–	1,358 72	1,237 90	2,596 62
Brookline,	–	356,642 00	80,036 00	29,820 00	–	1,817,844 45	102,179 80	31,759 05	133,938 85
Cambridge,	–	386,457 50	97,541 20	32,316 00	1,316,799 00	–	91,684 13	63,439 92	155,124 05
Canton,	–	14,729 00	3,295 60	1,236 00	–	–	1,084 04	987 91	2,071 95
Chelsea,	872,594 39	86,014 50	53,114 80	7,188 00	293,139 00	–	72,277 30	29,329 91	101,607 21
Cohasset,	–	–	–	2,196 00	–	–	106 11	86 01	192 12
Dedham,	–	40,469 00	9,073 60	3,378 00	–	194,918 43	11,119 53	5,643 22	16,762 75
Dover,	–	4,004 00	898 80	336 00	–	–	294 75	268 66	563 41
Everett,	635,171 58	74,145 50	85,300 40	6,198 00	252,296 00	–	57,753 19	24,413 97	82,167 16
Hingham,	–	17,446 00	3,937 60	1,458 00	–	–	1,285 60	1,171 10	2,456 70
Hull,	–	15,301 00	3,424 00	1,278 00	–	–	1,125 86	1,026 06	2,151 92
Hyde Park,	18,881 53	43,257 50	13,225 20	3,618 00	–	220,851 79	13,688 34	8,411 06	22,099 40
Lexington,	102,473 00	–	–	–	46,530 00	–	8,099 87	2,383 41	10,483 28
Lynn,	–	195,409 50	46,352 40	16,338 00	–	–	14,524 72	13,196 40	27,721 12

Malden,	569,615 97	115,329 50	62,830 40	9,642 00	392,920 00	–	61,868 86	28,860 88	90,729 74
Medford,	553,237 66	77,291 50	121,509 20	6,462 00	263,153 00	–	55,762 21	21,513 73	77,275 94
Melrose,	429,558 55	55,198 00	12,369 20	4,614 00	188,188 00	–	37,690 55	13,167 32	50,857 87
Milton,	220,272 54	88,660 00	88,981 20	7,416 00	–	451,742 29	41,877 39	13,013 84	54,891 23
Nahant,	64,111 32	26,312 00	17,590 80	2,196 00	–	–	6,267 54	2,774 24	9,041 78
Needham,	–	14,943 50	3,338 40	1,248 00	–	–	1,099 25	1,001 88	2,101 13
Newton,	93,708 28	248,748 50	55,854 00	20,802 00	–	1,268,224 66	76,666 19	30,770 31	107,436 50
Quincy,	737,815 23	83,297 50	44,169 60	6,966 00	–	424,135 82	67,643 98	22,777 56	90,421 54
Revere,	326,987 86	41,654 50	116,244 80	3,480 00	142,175 00	–	34,540 05	14,434 69	48,974 74
Saugus,	–	14,872 00	3,338 40	1,242 00	–	–	1,094 87	997 65	2,092 52
Somerville,	1,627,146 74	204,919 00	64,071 60	17,130 00	697,950 00	–	142,760 60	56,005 97	198,766 57
Stoneham,	145,630 13	18,018 00	4,023 20	1,506 00	61,523 00	–	12,617 66	4,987 07	17,604 73
Swampscott,	–	37,966 50	8,517 20	3,174 00	–	–	2,794 94	2,546 82	5,341 76
Wakefield,	–	29,315 00	6,591 20	2,454 00	99,781 00	–	6,905 10	5,880 89	12,785 99
Waltham,	–	81,224 00	18,232 80	6,792 00	–	414,097 10	23,275 13	14,681 70	37,956 83
Watertown,	234,134 51	45,045 00	10,100 80	3,768 00	–	229,217 38	26,339 49	9,022 42	35,361 91
Wellesley,	–	41,827 50	9,373 20	3,498 00	–	–	3,078 66	2,805 50	5,884 16
Weston,	–	24,381 50	5,478 40	2,040 00	–	–	1,795 43	1,635 90	3,431 33
Westwood,	–	7,793 50	1,754 80	654 00	–	–	574 19	523 11	1,097 30
Weymouth,	–	24,810 50	5,564 00	2,076 00	–	–	1,826 43	1,664 31	3,490 74
Winchester,	–	38,038 00	51,231 60	3,180 00	129,250 00	–	11,314 58	7,186 28	18,500 86
Winthrop,	231,843 18	30,459 00	6,848 00	2,544 00	103,400 00	–	20,479 78	6,899 75	27,379 53
Woburn,	–	39,754 00	8,902 40	3,324 00	135,454 00	–	9,368 50	8,167 11	17,535 61
Totals,	$34,000,000 00 [1]	$7,150,000 00 [1]	$2,140,000 00 [1]	$600,000 00 [1]	$5,170,000 00 [1]	$8,365,598 00	$3,104,575 21	$1,098,257 07	$4,202,832 28

[1] Odd figures omitted to facilitate computation.

TABLE C. — *Showing Growth of Net Metropolitan Debt.*

1906, 1907 and 1908 assessments include Wellington bridge. 1908 ($20,866.67) assessments include Wellington bridge, Wellesley bridge and Metropolitan Improvements Commission.

	1890.	1891.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.
Sewers: —										
North, . . } South, . . . }	$3,000,000 00	$3,368,000 00	$4,318,715 53	$4,940,932 94	$5,406,880 54	$5,965,432 62	$6,179,271 87	$6,480,707 68	$6,676,543 14	$7,628,583 41
Water, . . .	–	–	–	–	–	1,998,713 95	6,300,139 30	12,045,531 00	15,583,625 71	18,650,667 03
Parks: —										
Nantasket, . .	–	–	–	–	1,099,730 68	1,534,251 26	2,633,829 89	4,521,986 94	6,541,873 87	7,681,984 84
Wellington bridge,	–	–	–	–	–	–	–	–	–	–
Boulevards, . .	–	–	–	–	245,639 53	244,806 89	246,349 97	1,035,942 90	–	–
Charles River Basin,	–	–	–	–	–	–	–	–	–	–
Totals, . . .	$3,000,000 00	$3,368,000 00	$4,318,715 53	$4,940,932 94	$6,752,250 75	$9,743,204 72	$15,359,591 03	$24,084,168 52	$28,802,042 72	$33,961,235 28
Assessments, . .	–	–	$55,244 50	$99,795 16	$214,093 44	$277,586 69	$345,199 77	$338,134 98	$683,880 43	$925,944 11

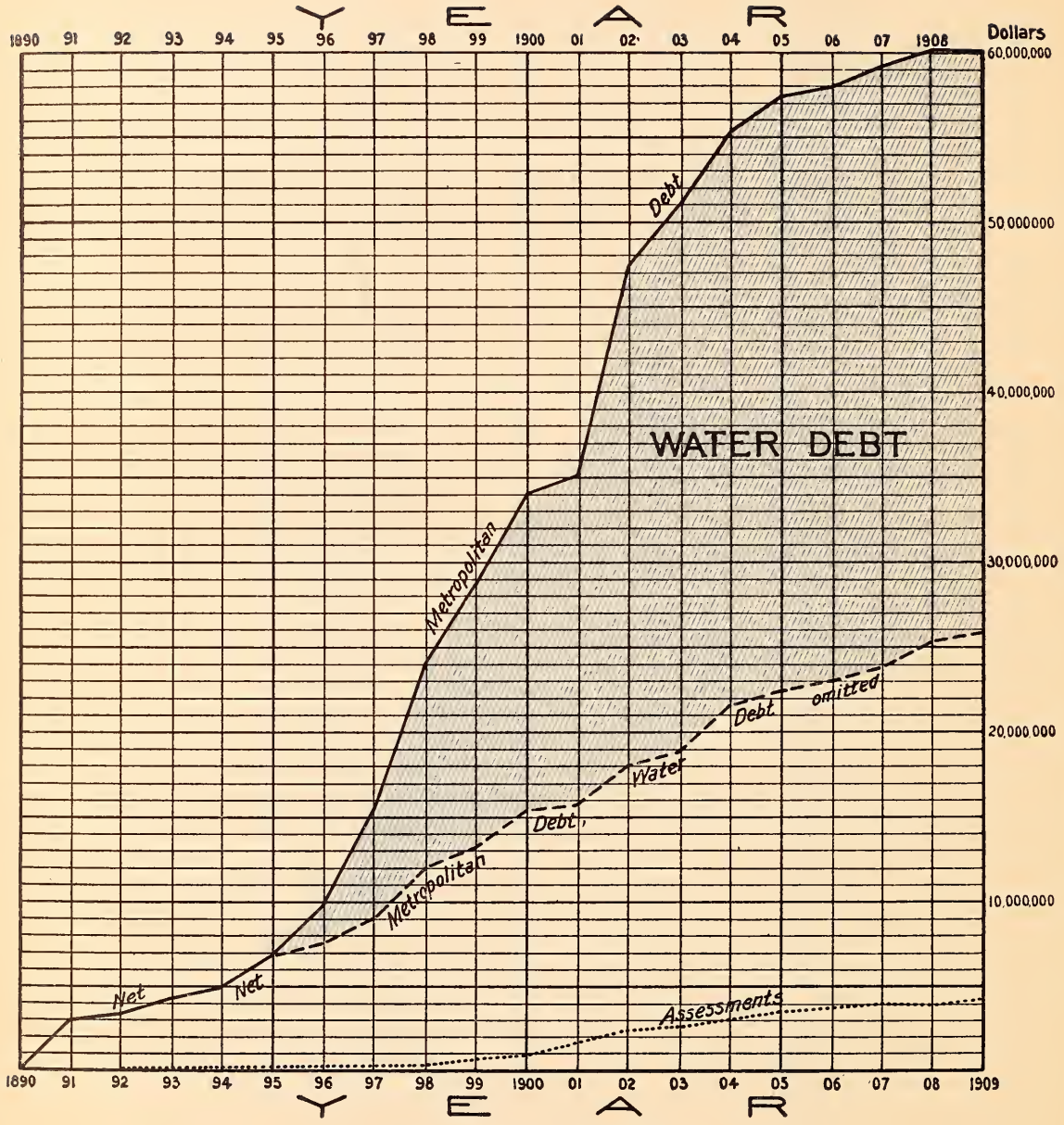


Diagram showing Net Debt
of the
Metropolitan District
from
1890 to 1909

February 1909

Frank L. Tibbetts, Del

Desmond FitzGerald, Eng'r

TABLE C. — *Showing Growth of Net Metropolitan Debt* — Concluded.

	1900.	1901.	1902.	1903.	1904.	1905.	1906.	1907.	1908.
Sewers: —									
North,	$7,811,391 43	$9,760,243 74	$10,533,827 96	$12,651,221 59	$5,454,004 28	$5,379,679 65	$5,358,333 29	$5,269,332 45	$5,171,037 95
South,					7,465,350 60	7,409,507 40	7,504,088 15	7,752,644 98	8,365,598 38
Water,	19,426,380 28	29,337,573 05	32,243,196 19	33,622,164 41	34,980,397 08	34,942,954 31	35,314,664 07	34,871,143 44	34,099,192 44
Parks: —									
Nantasket,	7,850,211 87	8,300,241 49	8,358,293 43	7,218,050 75	6,758,956 62	6,992,004 36	7,121,165 51	7,230,289 05	7,755,709 85
Wellington bridge,	–	–	–	–	624,156 61	611,962 50	601,235 55	588,028 08	–
Boulevards,	–	–	–	1,787,575 14	1,868,449 49	1,982,189 51	2,088,442 71	2,189,311 83	2,140,214 76
Charles River Basin,	–	–	–	–	237,376 62	609,968 48	1,099,887 20	2,292,973 56	2,660,469 76
Totals,	$35,087,983 58	$47,398,058 28	$51,135,317 58	$55,279,011 89	$57,388,691 30	$57,928,266 21	$59,087,816 48	$60,193,723 39	$60,192,223 14
Assessments,	$1,680,253 86	$2,452,184 48	$2,606,511 24	$3,018,400 15	$3,519,609 82	$3,722,725 93	$3,975,114 40	$3,963,700 68	$4,237,127 45

Water Ways.

BY RICHARD A. HALE, CIVIL ENGINEER.

As requested, I have made examinations on the subject of inland water ways as bearing on the relations of the Metropolitan District to other portions of the State, and present the following results of the investigations.

The first portion of the report relates briefly to a history of the various canals and water ways that have been projected in Massachusetts during the last century. I have investigated the possibility of the revival of the old Middlesex Canal and also the construction of a canal across the State from Boston to the Hudson River, and the probable estimate of its cost, and these matters are given in detail in the latter portion of the report.

The various canals in connection with inland water ways of Massachusetts may be briefly summarized as follows: —

Middlesex Canal.

The Middlesex Canal Company was incorporated in the year 1793, for the purpose of constructing a canal that should connect the Merrimac River just above Lowell with the waters of the Charles River at Charlestown. It connected with the Merrimac River at a point about 1 mile above the Pawtucket Falls and running northerly reached a summit level at Billerica, a distance of 6 miles from the starting point; thence crossing the Concord River it continued in a gradual descent through the towns of Woburn, Winchester and Medford, a distance of about 22 miles, to its terminal point at tide water at Charlestown. From the Merrimac River to the summit at Billerica the rise in elevation was 32 feet; thence from this summit the descent to tide water at Charlestown was 104 feet. The width of the canal was 30 feet at the water surface and 20 feet at the bottom; the depth of water was 3 feet. The rise and de-

scent necessitated the constructing of 20 locks, besides 50 bridges that were necessary for the highway and other crossings. The canal barges had a capacity of 14 tons and were drawn by single horses at the rate of 3 miles per hour. The time of transit was for barges going downward to Charlestown five hours, and for boats returning, going upward to the Merrimac River, seven hours were necessary. The expense of transporting a ton of merchandise the length of the canal was $3.50; of this amount $1.70 was paid for toll and $1.80 was paid for freight.

The cost of constructing the canal was about $700,000, and assessments were levied for making various additions, repairs, etc., making a total cost of $1,164,200. Timber was the principal article transported and the average income for three years was $30,000 annually. The company owned mills at Charlestown and at Billerica on the Concord River which yielded some income. The canal was open for traffic in the year 1808. In the year 1810 the tolls on the canal were $15,000 and in the year 1836 had increased to $30,000. The revenues of the company continued to increase until the year 1835, during which year the Boston & Lowell Railroad was built, when they began to decrease and in the year 1853 they ceased entirely. Six years later the rights of the canal company were forfeited and the rights of the soil reverted to the original owners.

During the most prosperous times stockholders received 6 per cent. on their investment. The water rights were sold to mills on the Concord River.

Year.	Receipts.
1808,	$7,000
1811,	17,000
1815,	25,000
1820,	14,000
1825,	30,000

Boston & Narragansett Canal.

This route was suggested in the report of Secretary Gallatin in 1808, to extend from Boston harbor southward across Massachusetts to connect with Rhode Island via the Taunton River

and Narragansett, and was the first of a series of canals proposed for coasting vessels. The distance from Weymouth landing to Taunton on Taunton River is 26 miles. See later report on similar route in 1902.

Cape Cod Canal.

A survey was made in 1825 for a canal from the mouth of Scussett River at Barnstable Bay across the isthmus of Cape Cod, westward by canal to the mouth of Back River on Buzzards Bay, a distance of 7 miles. During the year 1825 about a mile was constructed and nothing additional was done.

Under the Acts of 1889 the Boston, Cape Cod & New York Canal Company was incorporated, and on Dec. 11, 1906, the joint board of Harbor and Land Commissioners and Railroad Commissioners was petitioned relating to the issue of bonds and stock. Various matters being approved, construction was begun in August, 1907. The work is not, however, being actively prosecuted, owing to business difficulties. As projected, the canal is 8 miles long and will cost about $6,000,000. The building of the water way will save about 75 miles and 145 miles respectively over present inside and outside routes. Forty thousand vessels round Cape Cod annually, bearing cargoes of 20,000,000 tons.

Boston & Connecticut Canal.

In 1826 a commission was appointed by the Massachusetts Legislature to report on the practicability of a canal from Boston harbor to the Connecticut River, and extending it to some point on Hudson River in the vicinity of the junction of Erie Canal and the river. An investigation and survey were made by Col. Loammi Baldwin of various routes to the Connecticut. The northern route appeared the most feasible, starting from the upper factory dam at Waltham and extending up the Charles to Stony Brook, across to Fitchburg, through Shirley, Groton, Littleton, Ashburnham (where the summit at Mud Pond was reached), thence through the mill pond at Whitney's Mill, Winchendon, and thence along by Millers River to its mouth below Durkes Dam. The distance was 100 miles

and the canal was to be 40 to 43 feet wide at the water surface, 28 feet at bottom and 5 feet deep. The reservoir ponds for supplying the canal are located in Ashburnham, Gardner and Westminster, and furnish a supply of about 634,000,000 cubic feet, which is sufficient for all seasons except during the winter months. The engineer's estimate of the cost was $3,000,000. This route was selected in preference to the southern route on account of the Blackstone Canal Company's interests in ponds necessary for canals.

Connecticut & Hudson Canal.

This canal project was intended to connect with the canal from Boston and form a continuous line to Hudson River, making connection with the Erie Canal. A preliminary examination located the lines as follows: starting below the mouth of Millers River and passing, by means of a dam and short canal, along the left bank of the Connecticut River and across the bend opposite the mouth of the Deerfield, thence up this valley to a summit level lying between the west and north branches of Hoosac River, and thence following the valley of the Hoosac River to the Hudson.

Blackstone Canal.

Two distinct canal companies were incorporated in 1823, by the Massachusetts and Rhode Island Legislatures, respectively, for the construction of a canal from Worcester to Providence. These were afterwards consolidated into the Blackstone Canal Company. Construction was begun in Rhode Island in 1824 and in 1826 was started in Massachusetts. The first boat passed through the canal in 1828. The construction had cost up to that time $750,000. The receipts from tolls reached a maximum in 1832, amounting to $18,907. The canal was never profitable to the owners; it was deficient in adequate water supply and was often visited by injurious floods. It was out of service during the winter months. It conferred a great benefit on the regions traversed, but was abandoned in 1848. This was due to the building of the Providence & Worcester Railroad in 1847, with which the canal was unable

to compete. The Blackstone River, from which water was taken for the canal, is used very extensively for manufacturing purposes and the power developed by the stream is of immense importance in connection with the industries along its banks.

New Haven & Northampton Canal.

The Farmington Canal received its first charter in 1822, from the State of Connecticut. It was begun in 1825, and was opened in 1828 as far as Farmington. Soon after it was prolonged to Southwick at the northern boundary. The Hampshire & Hampden Canal, the extension of the Farmington Canal in Massachusetts, was authorized in 1823 and was completed in 1829 as far as Westfield. In 1835 the canal was completed to Northampton.

These two canals, owned by separate companies, formed one continuous canal from Northampton, Mass., to New Haven, Conn., on Long Island Sound. In 1836 they suffered serious and heavy damages and were consolidated under the name of The New Haven & Northampton Canal Company. The traffic on these canals was of great importance, and from 1830 to 1836 annual receipts were $75,000. The expense of operating was so large and repairs were so numerous that the canal was never a paying one. In 1836 the new company assumed all indebtedness and paid nothing for capital stock.

Farmington Canal Company stock, ...	$537,195
Hampshire & Hampden Canal Company stock, . . .	269,000
Total loss, ...	$806,195

The canal was operated with 20 to 25 ton boats till 1845, when it was replaced by a railroad.

The entire loss on the canal was estimated at $1,089,425.

The entire length was 55 miles, the width 34 feet, and the depth was 4 feet. It had 50 locks 90 feet in length and 12 feet in width.

The Ship Canal from Taunton River to Boston Harbor.

By an act of the Legislature of 1902, the Board of Harbor and Land Commissioners was directed to report on the cost of building a ship canal from Taunton River to Wey-

mouth Fore River. The general route is from Weymouth Fore River, along the valley of the river to Weymouth Landing, thence along valleys of various streams, crossing the Old Colony Railroad south of Braintree station, thence across Dyer Hill and crossing the Taunton branch railroad, thence along the valley of Trout Brook and through the city of Brockton, thence crossing the railroad near Campello station and along various river valleys to a tributary of the Taunton River, thence down this valley to Taunton and thence to its mouth in Hope Bay. The length of the canal is 31.79 miles, of which 7.24 miles are on curves. Provision is made for 14 locks; 6 of these are between Boston harbor and the summit level and 8 between the summit level and the Taunton River. On the basis of 20 locks, 33,000,000 cubic feet of water will be required for daily operation. A pumping system is advised. The water surface of the summit level is 16,000 feet long, with an elevation of 130 feet; a uniform depth of 25 feet and a width on the bottom of 130 feet, with side slopes of 2 to 1 in earth and 180 feet in width in rock, are fixed for general dimensions. The proposed line crosses the railroad at eleven places. It will cross forty-six highways. Twenty drawbridges 100 feet in width will cross the canal. The estimated cost of the canal is $57,618,358.

Other Water Ways.

In addition to the canals already mentioned, there are other water ways which have been in use; as the Connecticut, where locks and canals were employed both at the Enfield dam and also above Turners Falls, making the river navigable for about 250 miles. These have been abandoned. A recent movement contemplates improved navigation to Springfield.

The navigation of the Merrimac from the sea to Lawrence and the cities above has been often discussed. A few barges of coal were sent up years ago by General Butler, who, with E. Moody Boynton, organized a navigation company. The great expense rendered the idea useless and it was quickly abandoned. Various investigations have been made in relation to the navigability of the Merrimac, but no practical methods have yet been devised.

Middlesex Canal.

This was an important route, connecting the manufacturing city of Lowell with Boston, which as a business center distributed the products of the former. The proposition to revive this canal raises the questions of its usefulness at the present time and the practicability of establishing it on the old route. The old canal transported white oak timber, pine, spars and lumber, cut in New Hampshire and floated down the Merrimac River. These entered the canal just above Lowell. The aggregate cost of the canal was $582,000, and it required about $40,000 net yearly income to yield 6 per cent. dividends, after paying expenses of management and repairs. The average annual receipts were but $27,930. The corporation controlling the canal owned mills at Charlestown and at Billerica which were of value. In 1843 a report was made by the agent of the corporation as to the general situation, in which the interesting fact was stated that although the work of construction was started in 1794, and the canal was completed in 1803, owing to extra expenses and repairs on the canal banks no dividends were declared until Feb. 1, 1819. Various assessments were made on shares, making the total cost of the canal $1,164,200, and there was paid in dividends $504 on each of the 800 shares, or $403,200. This equals a return of 1.39 per cent. per annum on the investment. From 1819 to the year 1835, when the Lowell Railroad was constructed, the dividends increased regularly from $10 to $20 per share, and without competition a handsome interest on the investment would have resulted. During the year that the Boston & Lowell Railroad went into operation the receipts were reduced one-third. When the Lowell & Nashua went into operation they were reduced another third. Those of the last year (1843) did not cover expenses for repairs and maintenance. The suggestion was made that only the portion of the canal from the Concord River to Woburn Locks be retained and used as an aqueduct to convey water from the Concord River to Woburn and thence by iron pipes to Boston and Charlestown. The quantity of water lost by evaporation and filtration was estimated at 50 cubic

feet per minute, and a record kept at Chelmsford showed the locks operated 6,000 times per year. The total amount of water estimated necessary for the locks and evaporation was 10,960,000 gallons per day, or nearly 15.4 cubic feet per second for twenty-four hours. In addition to the above a large amount flowed over waste weirs, and the lock tenders had to draw on the next level above to maintain a proper level in the section under their control; an estimate made in regard to the amount necessary for this purpose, from the testimony of attendants, was 2,000,000 gallons per day per mile, or 3.1 cubic feet per second for 28 miles, equal to 86.8 cubic feet per second. This amount added to the locks and evaporation equals 102.2 cubic feet per second for twenty-four hours. This will be referred to later.

The agent of the canal considered that the Legislature gave the railroad rights to build parallel with the canal and alongside of it in such a way as to destroy the rights of the canal given by the Legislature, and that the canal company should be compensated therefor. He considered that the canal property would become very valuable if steam power had not been introduced by railroads. Many considerations induce the merchant to prefer railroad to canal transportation, and the canal at the close of its career was carrying cheap and bulky lumber and fuel on its waters. Such articles of little value cannot afford to pay high rates of toll. A serious inconvenience was the termination at the Merrimac River, where boats passing to Concord and other towns were detained by freshets one, two or three weeks before reaching destination, causing an uncertainty that the merchant would not risk when within twenty-four hours he could receive his goods by railroad for the entire distance with no water risks. Before the railroads were built the merchants were accustomed to visit Boston twice a year and purchase large stocks. At the time of the report in 1843, and since the time when railroads were built, they visited Boston each month and obtained quickly what was required. This enabled them to do business on less capital with less risk on market changes. They were accustomed to leave home in the morning, make purchases, reach home the same night, and the

following day their goods were delivered, with transportation in one twentieth part of the time by water. For the preceding reasons it was concluded best to discontinue the canal and sell the property.

A remonstrance was presented by the Middlesex Canal Company to the Legislature at the time of the petition for a railroad for a road from Boston to Lowell. The remonstrants set forth that over a million dollars had been invested in their property. They anticipated that a water way might be extended across the country to the Connecticut River, and, making a connection with Concord, bring in the upper valley of the Connecticut and open up an extensive commerce with Boston and Concord, N. H., and the upper portion of the Connecticut valley and Canada. For this reason they were surprised at a petition for a railroad and at the same time were reluctant to present objections to public improvements. The transportation of goods was suspended in the winter months on the canal. Passengers were safely carried from Lowell to Boston in three hours by canal. The railroad had not been tested for passengers and it was considered that there was no inducement to extend the road westerly to the Connecticut River. The petition of the railroad company was granted by the Legislature; the canal company in 1859 forfeited their rights and the land reverted to the original owners.

The water used for supplying the canal was sold as water power to the Talbot & Faulkner Mills at Billerica and at present is used in developing power for manufacturing purposes.

I have entered quite fully into details as many facts appear that should be of value in connection with developing inland water-way possibilities.

In considering whether this canal could be revived for navigation purposes, the question of its location should be first considered. The location of the old route is still visible at many points between Lowell and Boston, and recognized by embankments, excavations and trenches, which still retain their original forms. Through Woburn and Winchester it is visible near the railroad, and at Billerica near the Talbot Chemical Works, where it is prominent. This location represents many

different owners and extends through valuable estates a portion of the way. At Billerica the old bed is used by the chemical works in connection with manufacturing processes. The ruins of the abutments of the aqueduct are visible at various points, particularly near the Shawsheen River. The terminals at Mystic River and Charlestown are built upon and occupied by various buildings, which would preclude the revival of this route. The entire route would be extremely difficult to revive on account of the change in conditions, such as changes in ownership and various uses for which the location is now adapted.

The quantity of water necessary for the supply of the canal has been previously mentioned, and from careful estimates made at the time the canal was in actual use the amount necessary for the whole distance was 102 cubic feet per second per twenty-four hours. The only source from which such an amount could be obtained would be the Concord River at Billerica, and this water is now used by the mills for water power and manufacturing purposes. The drainage area is 346 square miles above the dam at this point, excluding the 72.5 square miles of the Sudbury. This would furnish sufficient water for a portion of the year, possibly six months, and at other times there would be a lack of water in varying amounts, which would have to be supplied from other sources. Possibly the above estimated quantity might be reduced by careful management, but a margin for safety would still be required.

The value of the water used at present on the Concord River for power and manufacturing purposes will be briefly considered. As a basis of comparison the awards in 1877, at the time of the Sudbury River taking by the city of Boston, are presented. The watershed that was taken was 72 square miles and the damages awarded amounted to $438,000. The actual amount paid was about $342,000. This included the Saxonville Mills, whose entire power was taken, and the location of this mill is above the point at which it would be necessary to take the water at Billerica. All of the remaining mills would be affected, as in 1877, by any taking, including the Talbot & Faulkner Mills, Wamesit Power Company Mills and the mills

at Lawrence. Deducting the Saxonsville Mills the amount awarded was $263,000, or $227,000 actually paid.

The quantity necessary for the canal would be represented by a drainage area fully 50 per cent. greater, and on this basis the amount would be about $400,000 on the terms of settlement in 1877. This could be considered only as a slight index of damage, as the conditions have changed since the thirty years which have elapsed, which would make the value much greater than such comparison would indicate. The general growth of manufacturing has increased very materially since that time, and water for manufacturing operations, such as condensing water, water for use in the dyehouse and for washing goods, scouring wool and in connection with manufacture of paper is of great value. This large diversion would mean a very expensive substitution either of city or town water or the installation of filters to render the river water suitable for use, especially during long periods of low flow. The amount awarded was very much less than the amounts claimed by the mills as their actual damage, and in view of the fact that uses of water are more extensive than they were thirty years ago, the damages would probably be at least 50 per cent. additional and possibly 100 per cent., making amounts from $600,000 to $800,000 for the cost of water for the canal. During the dry months it would be a very serious problem for the mills on the Concord River and would mean much more than simply steam substitution.

The foregoing figures will show the practical difficulties of the water supply problem and the damages which might be expected in connection with manufacturing establishments that are dependent on the stream. The difficulties of obtaining the original route, or an approximation to it, the large cost of water supply which at low stages of flow would be insufficient, and the general reconstruction would amount to a very large sum, from which but a small return would be received judging from past experiences with the canal in comparison with railroad transportation.

The history of the Middlesex Canal affords such an excellent example of water transportation and its practical workings that it has been stated in detail.

The Boston & Connecticut River and Hudson River Canals.

In considering a canal location across the State of Massachusetts, Col. Loammi Baldwin's investigations in 1826 of various routes may be examined. His studies of routes led him to the conclusion that the northern route, so called, was the most feasible both in regard to grades and water supplies. This appears to be the most practicable route across the State. The following is a brief description. Starting in the Charles River basin the canal follows the valley of the Charles through Watertown and Waltham, thence through the valley of Stony Brook, following its upper branches through Lincoln and crossing the Concord River passes through North Sudbury near the station, thence through Acton, Boxborough, Littleton, Groton, Shirley village and along by Massapoag Pond to Fitchburg, thence following along a tributary of the north branch of the Nashua until the summit level is reached, at Mud Pond in Ashburnham. The total distance is 57 miles and elevation about 1,050 feet above mean low water in Boston harbor. Extending westerly from Mud Pond the line follows the outlet of this pond and also one of the tributaries to Millers River, along the valley of Millers River through South Royalston, Athol Center, West Orange, Erving, Millers Falls until it reaches the Connecticut. The general course of the canal follows the valleys, but owing to the crooked course it would be necessary to make deep excavations, as the hills are abrupt and thickly wooded. In many places ledge is visible and rock excavation would be necessary. The general character of the river bottom is rocky. The total distance of this section is about 38 miles, with a fall of 893 feet from the summit at Mud Pond to the Connecticut River.

From Connecticut River to Hudson River.

Just below the mouth of Millers River on the Connecticut a dam raises the water above the rapids and permits boats to pass down the river through locks on the west side. At Montague is a dam 1,000 feet long, by which rapids between the

two dams are submerged. A mile below Millers Falls a new dam can be built at the narrow part of the river and the larger dam abandoned below. The canal route passes down the Connecticut to the mouth of the Deerfield, thence up this valley following the general line of the stream to the Hoosac Mountain. A tunnel is necessary through the mountain, and the route extends westerly through Florida, North Adams, Pownal, Hoosac River, following the valley of the latter stream to the Hudson River. The total distance from the Connecticut to the Hudson is 78 miles. From the mouth of the Deerfield to the summit of Hoosac Mountain is 34 miles, and the elevation is 2,060 feet above the water in the Connecticut River.

The location of the canal route as proposed by the commission in 1826 would be very expensive at the easterly terminus at the Charles River basin in consequence of the land values in that vicinity. Proceeding up the valley of the Charles River the same condition prevails through Watertown, Bemis and the city of Waltham. Beyond this point the conditions are more in the open country, until the valley of Millers River is reached, where manufacturing interests are very extensive and valuable. The location of the canal is dependent to a great extent on the water supply, which is necessary for its successful operation and is a very important factor in this case. As a general statement it may be said that the ponds and rivers mentioned in the report of 1826 as sources of feeders to the canal are in use either by cities and towns for a water supply or utilized as water power and in manufacturing interests by manufacturers who have established water-power plants. An examination of the list of cities and towns shows that 16 of them draw their domestic water supplies from ponds and rivers that would be utilized in a supply for a canal. The valleys of Charles River, Millers River and Hoosac River are filled with busy manufacturing establishments. A diversion means something more than a mere loss of water to be replaced by steam; it means a diversion of water now used in dyehouses and various other processes.

The general route of the canal through Watertown, Bemis and Waltham would follow the valley of the Charles River and adjacent to manufacturing establishments, where land is

of great value. At the lower dam at Watertown are various manufacturing plants using the water in connection with their special processes. The Ætna Mills, just above this dam, utilize the water on about 6 feet fall. The Waltham Bleachery, a short distance up stream, makes use of the water for bleaching and rinsing purposes, and the Boston Manufacturing Company uses the water on modern turbines to develop power and also for steam power and general manufacturing uses. The general line of the canal passes through Lincoln, and crossing the Sudbury River passes through West Acton, Boxborough and Littleton. Spectacle Pond, Forge Pond and Sandy Pond, which would be necessary for the canal, are tributary to Stony Brook, which flows into the Merrimac above Lowell. These various ponds are controlled by mill owners on the stream as storage ponds incidental to the water power. At Shirley the ponds are used for water power in connection with mills running by steam power. The ponds in Ashburnham are partly tributary to Millers River, and all are used for storage reservoirs by the mills on the streams below. The general line follows Millers River near Whitney's Pond in Winchendon, where the water power is utilized by a modern water-power plant. The total fall at Millers River is about 600 feet, of which the greater part is utilized for water power at Royalston, Athol, Orange, Erving and Millers Falls. The line of the canal through this valley would necessitate interference with the mills which use the power extensively, and all available land is required in connection with manufacturing operations. The use of the water for the supply of the canal would make a serious interference with the summer flow of the river for the mills. About 30 privileges are located on this stream.

The route of the canal below the mouth of Millers River follows the Connecticut to Turners Falls. The dam just below the mouth of Millers River and extending across the Connecticut, referred to by Mr. Baldwin, has been removed, and there are rapids in low water extending nearly down to Turners Falls dam. Locks and canals would be necessary around the dam, as there is a long series of rapids down to the mouth of the Deerfield River.

The large water power at Turners Falls is fully utilized by the mills and a large investment is represented at this point. The route then extends up the valley of the Deerfield to the entrance of the Hoosac Tunnel. The water power is utilized at various points along the stream. At Hoosac Mountain the route would follow a line of tunnel through the mountain and connect with the head waters of the Hoosac River, thence following down the north branch of the Hoosac until it joins the main branch, thence following this branch to its mouth at the Hudson River. From this point it is feasible by the Hudson River to connect with various New York canals.

Width of Locations and Size of Canal.

The capacity of a canal for transportation should depend on the amount of traffic expected, and a brief reference to the experience of the New York Canal Commission will be of interest.

The Erie Canal as originally planned in 1817 had the following dimensions: —

Width at bottom,	28 feet.
Width at water line,	40 feet.
Depth of water,	4 feet.
Width of tow path,	10 feet.

This section was adapted for boats of about 30 tons capacity. As the traffic increased year by year larger boats were demanded, and in the year 1836 the cross section of the canal was enlarged and the depth of water increased to 7 feet. The bottom and top widths were 58 feet and 70 feet respectively. Enlargements were made at intervals during the succeeding years, owing to an increased demand for transportation, and in 1903 a bill was passed, known as the "barge canal act," authorizing the enlargement of the State canals and providing that the cross section should be increased to the following dimensions for earth section: —

Width at bottom,	75 feet.
Width at water line,	133 feet.
Depth of water,	12 feet.
Width of tow path,	16 feet.

The sides were constructed with a slope of 1 foot vertical to 2 feet horizontal. Sections in ledge were modified from the earth section, and in cities and towns modifications in width were made depending on the conditions of location. The locks were 310 feet in length by 28 feet in width and had a minimum depth of 11 feet of water on their sills. The barges were 150 feet in length by 25 feet in width, with 10 feet draught and a capacity of 1,000 tons. The enlarging of the canals has been in progress since the passage of the act and is still carried on. In the year 1905 an important amendment was made, increasing the size of the locks to 328 feet in length and 45 feet in width, with a depth of water of 12 feet. This provides for passing the larger lake boats, and the locks are being constructed of this increased width.

In considering the dimensions of a canal from Boston to the Connecticut, it would be reasonable to adopt the cross section of the barge canal of the act of the year 1903. Mr. Baldwin suggested a canal 28 feet wide on bottom, 43 feet wide at surface and a depth of water of 5 feet, which is much smaller than the barge canal section.

Width of Location.

From the dimensions stated the total width of canal, including the tow path, is 149 feet. To allow for slopes and walls and necessary repairs a minimum width of 200 feet would be required, which might be reduced in constricted localities. In a mile there would be required 1,056,000 square feet. Although in the country the value of the land might be very small, there would be locations along the river valley passing manufactories where the land is very valuable and for an estimate I should place it at 20 cents per square foot, or $211,000 per mile. The total distance along the route from Boston to the Connecticut River is about 95 miles, making the cost for land damages $20,045,000.

Cost of Construction.

The route from Boston to the Connecticut River will be first considered. The length of the proposed canal from Boston to the summit at Mud Pond in Ashburnham is 57 miles, with

a rise of 1,050 feet. Assuming 12 feet rise for each lock, 88 locks, or about 1½ locks per mile, would be required. From the summit at Ashburnham to the mouth of Millers River at the Connecticut is 38 miles, with a fall of 893 feet. This will require about 75 locks, or 2 locks to each mile. To ascertain the actual cost detailed surveys would be necessary; these are impractical, and a general estimate is made from the cost of canals that are constructed. The cost of various canals in New York State has varied from $30,000 to $64,000 per mile, depending on conditions, applying to canals of smaller section than the barge canal. A reasonable amount to assume for the cost would be $100,000 per mile, which would include locks, bridges, aqueducts, etc., in addition to the canal embankments and walls. For the total distance of 95 miles this cost would be $9,500,000.

Water Supply for the Canal.

The amount of water required for the canal is dependent on the amount of traffic, and I have assumed that the locks would be opened thirty times per day, and as the capacity of 1 lock is about 112,000 cubic feet, this would require 3,360,000 cubic feet per day, or 40 cubic feet per second. The experience on the Erie Canal has shown that with a canal with a depth of 7 feet, 5 cubic feet per second per mile in length were required for lockage, loss from seepage, etc. The experience on the Middlesex Canal has shown about 4 cubic feet per second per mile. On the canals across the State I consider that 5 cubic feet per second per mile would be a fair estimate to assume, considering the traffic as stated. A larger amount might be necessary at times, but with a fair amount of storage in the lower reaches an economical use can be made of this quantity. This would necessitate taking all of the streams and ponds in the vicinity of the canal route in addition to a supply to be obtained from a distance. Much of the water is used as city and town supplies, and could not be taken without serious detriment. In the lower reaches at the eastern terminus it is of value for manufacturing purposes. For the estimate of the eastern portion of the canal from Mud Pond to Boston the distance is 57 miles, hence 285 cubic feet per second would be required to supply the canal. This amount for eight months

is equivalent to 213 cubic feet per second for the year. If concentrated for manufacturing purposes into ten-hour use daily and storage for Sunday, it would be 600 cubic feet per second. The total fall is 1,050 feet. Assuming that this quantity is available on two-thirds of this fall, or 700 feet, the power would be 35,720 net horse power, which at $500 per horse power would equal $17,860,000.

On the western descent the water powers on Millers River are very generally developed. The total distance is 38 miles, requiring 190 cubic feet per second. Considering that 200 cubic feet per second is necessary for eight months in the year, we have 150 cubic feet per second for a year. If used in ten hours we have 420 cubic feet per second. The total fall is 900 feet, and assuming that two-thirds of this is utilized, the power under 600 feet head is 21,460 net horse power; at $500 per horse power this equals $10,730,000.

Summary of Cost from Boston to Connecticut River.

Location rights,	$20,045,000
Construction of canal, locks, etc.,	9,500,000
Water rights, easterly portion,	17,860,000
Water rights, westerly portion,	10,730,000
Total,	$58,135,000

Millers River to the Deerfield along the Connecticut.

For a distance of 7 miles the canal would follow the Connecticut River, passing Turners Falls by means of locks. The construction would be very expensive and difficult, and an estimate of $100,000 per mile would be insufficient. I estimate the total cost of construction at $1,000,000, and the location rights for a width of 200 feet at $1,477,000. Any diversion of the water rights at Turners Falls would very seriously damage their property, owing to the various enlargements of canals and head gates that have been effected in recent periods.

The use of the water for lockage cannot be considered on the same basis as in other portions of the canal as the water of the river is partly used, but the loss and interference with power may be estimated at $800,000.

Summary of Cost from Millers River to the Deerfield.

Canal construction,	$1,000,000
Location rights, 7 miles,	1,477,000
Water rights,	800,000
Total,	$3,277,000

Mouth of Deerfield River to Hoosac Mountain.

From the mouth of the Deerfield along the valley to the base of Hoosac Mountain the distance is 30 miles and the elevation 611 feet. This would require 60 locks, or 2 locks to the mile. The location along the valley would be difficult, owing to the steep banks and precipitous rises. For location damages the land would be of less value than on the eastern portion of the route, and I consider that an estimate of 10 cents per square foot would be reasonable, or $105,600 per mile. For 30 miles the cost equals $3,168,000. The quantity of water required for a distance of 30 miles is 150 cubic feet per second for eight months, or 112 cubic feet per second for a year. If used in ten hours with storage this is equivalent to 314 cubic feet per second. The total fall is 611 feet, and considering that two-thirds of this is available, or 407 feet, the power is equal to 10,870 net horse power, which at $500 per horse power equals $5,435,000.

Canal construction, 30 miles at $100,000,	$3,000,000
Land rights and location,	3,168,000
Water rights,	5,435,000
Total,	$11,603,000

Hoosac Mountain.

The problem of crossing the mountain range is a difficult one and tunneling the mountain would require a section of about 75 feet in width in addition to tow paths, making 100 feet total. The depth of water would require 12 feet and 8 feet of head room, making a section of about 1,700 square feet. This would be equal to 3 yards per running foot, and

considering that it would cost $5 per cubic yard in such a location the cost would equal $315 per running foot, or $1,663,200 per mile. A length of 5 miles is necessary to connect the upper reach of the Deerfield with the north branch of the Hoosac, and the total cost would be $8,316,000. The general character of the work, together with the water rights, would probably increase the estimate to $10,000,000. The summit of the Hoosac Mountain is about 2,060 feet above the level of the water at the mouth of the Deerfield, and about 1,450 feet above the surface of the water near the tunnel entrance. The elevations of the Hoosac range are such that to carry a canal over the range would be prohibitive. The gorge at Stamford and Reedsborough has been considered, but the distance would be increased about 18 miles, and extra locks required in a very difficult country, where the construction would be very expensive.

From Hoosac Mountain to Hudson River.

This distance is about 44 miles following along the valleys of north branch and main branch of the Hoosac River to the Hudson. Many manufacturing establishments are located on the stream and the power is fully utilized. The fall is 711 feet from the surface at the west end of the tunnel to the Hudson River. About 60 locks are required, or 1.4 to a mile. For a distance of 44 miles 220 cubic feet per second would be required for eight months, or an average of 165 cubic feet per second per twenty-four hours for the year. If used during ten hours per day with storage this would equal 462 cubic feet per second. Assuming that two-thirds of the fall is available, or 474 feet, the power is equal to 18,620 net horse power, which at $500 per horse power equals $9,310,000. I estimate the cost of location at $211,000 per mile for 44 miles, which equals $9,284,000.

Summary of Cost from Hoosac Mountain to Hudson River.

Canal construction, 44 miles at $100,000,	$4,400,000
Land rights and location,	9,284,000
Water rights,	9,310,000
Total,	$22,994,000

Summary of Cost.

A summary of the estimates of cost of the various portions of the route is given below: —

Boston to Connecticut River,	$58,135,000
Mouth of Millers River to mouth of Deerfield River on the Connecticut River,	3,277,000
Mouth of Deerfield River to entrance to Hoosac Tunnel,	11,603,000
Tunnel through Hoosac Mountain,	10,000,000
Hoosac Mountain through Hoosac River to the Hudson River,	22,994,000
Total,	$106,009,000

The total cost of the entire route from the Charles River basin to the Hudson River is thus estimated at about $106,009,000. This provides for barges of 1,000 tons capacity, such as are to be used in the New York Barge Canal. The rate of speed on the New York canals is limited to 4 miles per hour and will not exceed 3½ miles in usual practice. The traffic would be limited to eight months of the year, and the canal would remain out of use the remainder of the year, during the winter months. Experiments on electrical propulsion have been tried to attain a speed of 5 miles per hour but nothing practical has been developed that would prevent the wave wash in the canals.

The matter of the transportation of grain and similar freight from the Hudson to Boston by water, when speed and economy of time are such important elements, is questionable. A large business would have to be assured to pay the interest, maintenance and care of the canals, and the experience of the Middlesex Canal has shown that in that locality the water transportation could not compete with railroads. A canal of smaller dimensions could be built at less cost than the size on which the estimates were based, but no material reduction could be effected. Whatever size might be adopted the question of a water supply is a very serious matter, as all available ponds and streams are in use either for water supply or water power, and the expense of obtaining the water supply could not

be materially reduced. The manufacturing interests of this State are so great that nothing should be done that would conflict with them. From the investigations made it does not appear that a canal would be warranted extending across the State. The interest at 4 per cent. on $106,000,000 is $4,240,000, and the cost of maintenance, repairs, etc., will increase this amount materially.

1882 the Erie Canal moved about 3,700,000 tons of merchandise, receiving $587,858, or about 16 cents per ton. In 1905 the movement on the same canal was about 2,000,000 tons, and there has been a falling off in the total tonnage of all the canals in recent years.

If the locks are opened thirty times daily, allowing 30 boats of 1,000 tons' capacity to pass, going in either direction, the traffic would amount to 30,000 tons per day for eight months, or 7,200,000 tons annually. The total mileage of the Erie Canal is about 353. The Massachusetts canal has a total length of 180 miles, or about one-half the length of the Erie Canal, and with the increased lockage would require more time in handling the traffic. If the rate of 10 cents per ton could be received the annual income would be about $720,000, or about one-sixth the amount required to pay the interest. From the above examination it appears that such a canal would prove an unprofitable investment for the Metropolitan District.

A southern route was examined, but the difficulty in the water supply and the high range of mountains in the western portion of the State did not indicate a feasible route.

The revival of other canals throughout the State has not been specially considered as the difficulties presented in water supply and construction would equal or exceed those that exist in the two canals that have been discussed.

Experience has shown that in the canals that were abandoned the advent of railroads caused such an improvement in transportation that a renewal of such water ways could hardly be considered under present conditions. No new routes suggest themselves as being more advantageous.

Nov. 14, 1908.

The Water Front of Boston Bay.

BY SYLVESTER BAXTER, SECRETARY.

Boston's harbor, with the numerous subordinate havens around the bay, is the greatest natural asset of this metropolitan community. By reason of it the city came into being, has waxed and prospered. A cluster of municipalities has gradually grown up about it, until physically the whole has become one vast urban population which primarily owes its existence to this circumstance.

Geographical Character.

Geographically the bay and its tributary waters make a most interesting study. In various respects the opportunities presented for a continuous development of one of the great ports of the world are ideal. Numerous islands break the broad waters into sheltered roadsteads. Branches of the harbor — estuaries, salt creeks and other inlets — extend far into the land, ramifying in various directions and carrying commerce to convenient destinations. These harbor arms have large potentialities which in European ports would have been realized to their fullest advantage. Hamburg, for instance, has expended vast sums in the creation of facilities for economically distributing water-borne commerce to all practicable points throughout the city and its adjacent communities. In the case of Boston, nature provided these facilities ready at hand. Indeed, in earlier days these water ways were highly appreciated, and were well utilized for the more limited commerce of those times. With the advent of railways the commercial utilization of these features has in various instances diminished, and for this or that reason some of them have fallen into almost absolute disuse. Nevertheless, since they still remain, possibly even greater uses may in time be developed for them. One reason why their

utilization has diminished is that marine traffic is now carried on in larger units. Channels sufficient for the craft of former times have long since proved inadequate; failure to improve them led to the neglect of the opportunities which they provided. Industries in their neighborhood fell more and more into the habit of depending upon the railways for what was formerly carried by water. Such water ways, therefore, became atrophied in their functions. Whether other habits in transportation may not have become so confirmed during their long disuse as to render impracticable a restoration to the normal utilizations that suggested channel improvements would seem to invite is a question. This almost complete change in transportation habits from water ways to rail is not only a local but a national phenomenon, in sharp contrast with European developments.

The Charles River.

Of these arms of the harbor, what until the recent radical changes took place was the Charles River estuary is by far the largest, and was formerly of greater relative importance than at present. It is about 9 miles from the confluence of the Charles and the Mystic rivers to what until recently was the head of tide water at Watertown. Both in value and bulk, however, the water-borne traffic of the Charles is now vastly greater than in the days when Cambridgeport had its origin, and received its name in large projects for a commercial development of its extensive front. Here at Cambridgeport and East Cambridge two canals were constructed reaching far up into a district which originally was very largely a marsh. The river was navigable almost to the dam at Watertown, and vessels in considerable number ascended to that point. Its great basin, now contracted to less than half its former size, reached to the inner side of the slender isthmus known as Boston Neck, even the name of which has now practically disappeared from local nomenclature. Within the memory of persons now living and active vessels of 200 tons used to lie at wharves on Middlesex Street, between Dover and Castle streets.

The use of the river basin, which otherwise might have become one of the most important portions of the port, was discouraged by the construction of the several railroad bridges

across it. This circumstance was aggravated by obstructive piling and inadequate draws. These have gradually encroached upon the surface, until now the water is practically roofed in by more than 31 acres of pile-supported platforms utilized as a switching yard and for miscellaneous purposes. Nevertheless, an extensive commerce is still transacted above the bridges. That which passed through the draws of the railroad bridges in 1905 amounted to 682,032 tons, with a value of $3,726,612, as against 318,264 tons in 1891, — an increase of over 100 per cent. More than 6,000 vessels pass annually.

The recent damming of the river at what was formerly Craigie bridge, and its conversion into a great fresh-water basin or lake, now popularly known as "Charlesmere," with about 8 miles of slack water, has in a way even improved the navigable value of what was the estuary by keeping the water at a uniform level, somewhat below that of high tide in the harbor. The basin commission's expenditures for channel improvements amount to more than $325,000. The canals in Cambridge are, therefore, accessible at all stages of the tide; they have been dredged to a good depth and have become of correspondingly greater service to the industries along their banks. What is called the Broad Canal has a length of 7/10 of a mile, with 1 4/10 miles of water front. The Lechmere Canal, adjacent to the dam, is an L-shaped piece of water, and has a length of about 3/10 of a mile, with a water front of about 6/10 of a mile, — a total of about 2 miles for the two canals.

Ocean-going vessels of a considerable size, with masts, can enter that portion of the basin below the new West Boston bridge, the lock having a length of 350 feet and a width of 45 feet, with a depth of 16.4 feet above Boston base and 21 feet at its upper sill. One use to which the basin can be put is that of permitting war ships from the navy yard near by to be laid up in fresh water when out of commission. Almost any war ship below the grade of first-class cruiser can pass through the lock.

The great Cambridge bridge being drawless, the river above is barred to craft with masts. But large barges can navigate the river as far as Cottage Farm, where there is an extensive coal yard. Near by is the extensive plant of the Brookline

Gas Works. Farther up stream are several other wharves, the highest, excepting that of the arsenal, belonging to the abattoir in Brighton. In 1905 coal to the amount of 107,425 tons was carried to points above the Cambridge bridge. The improvement of the channel now in progress will carry vessels of fair size to the present head of navigation, just below the Watertown dam. The great arsenal at Watertown now receives all its coal and other bulky material by rail. Under the improved conditions, however, it has been suggested that it might easily be possible to obtain them by water; also to ship many of its bulky manufactured products to coast-wise points by this same channel. The arsenal wharf is deserted and grass grown, guarded by two large cannon of antiquated pattern. The elaborate and costly construction of its massive quay wall, handsomely built of smooth-faced granite in characteristic government fashion, tells of the early days of the institution, when the river, despite its shallow channel, was mainly depended upon for transportation facilities.

Between East Cambridge and Charlestown is the canal-like piece of water called Millers River, which is now all that remains of the old area of flats and shoals that carried the harbor waters up to Charlestown Neck, where the original peninsula of Mishawum, in its physical character, closely resembled Shawmut, across the river. Several large industrial establishments are served with coal, lumber, etc., by Millers River. But its use, although still regarded of importance by the Harbor and Land Commission, has been greatly diminished by the obstacles presented by the railroad bridges. This river has a length of more than a half mile above the bridges, with more than a mile of water front. Altogether there is a commercial water frontage of nearly 3½ miles on the Charles River between the railroad bridges and the drawless Cambridge bridge, available to ordinary seagoing vessels.

The Mystic River.

The second largest estuary, that of the Mystic River, has continued to develop and its commercial importance has enormously increased. The Mystic River has a length of about 9½ miles to the dam between the lower and the upper Mystic

lakes. From the confluence of the Mystic and the Charles, off the navy yard, about a mile of unobstructed navigation extends from the open harbor to Chelsea bridge. From Chelsea bridge to the present head of tide water at Medford is about 5½ miles. From the newly constructed dam at Cradock bridge there is about 3 miles of slack-water navigation, accessible from tide water by a lock. Here on the Mystic was built the "Blessing of the Bay," the first vessel launched in the colony. American shipbuilding, as a great industry, thus had its actual beginning here. In the early days of the nineteenth century the shipbuilding at Medford became of very great importance. Many of the best deep-sea ships were built there, and the term "Mystic built" characterized a vessel as of the very highest class of construction. On the lower shores of the Mystic, in Chelsea and East Boston, the air was always resonant with the clatter of wooden shipbuilding until shortly after the civil war, when the industry that had been one of Boston's greatest trades ever since the earliest days of the port almost completely vanished from this portion of the water front. It was continued only at a few establishments in East Boston and South Boston, ultimately reviving on the extreme southern shores of Boston Bay with the establishment at Quincy Point of the greatest modern shipbuilding plant in the United States.

On the upper Mystic tide-water commerce is now represented only by large coal yards at Medford and Somerville. The upper river was closed to general navigation by the abolition of the draw at Cradock bridge. The conversion of the river into a fresh-water stream from Mystic Pond to this point by the construction of a dam at Medford Center by the Metropolitan Park Commission makes the upper river conveniently navigable for pleasure craft and gives it a correspondingly high recreative value. The lock at Cradock bridge is 60 feet long, 15 feet wide and 5 feet below Boston base, giving a depth of 10.64 feet into the fresh water above at high tide. As with the Charles the fresh-water level is at grade 7.

Entering the Mystic between the Eastern and Western divisions of the Boston & Maine Railroad is the Malden River, — a salt-water creek which once carried a considerable commerce

as far as the center of Malden. It is navigable for a length of about 1½ miles. The banks of this water way are now desolate with abandoned wharves; a draw on the Saugus branch of the Boston & Maine Railroad was discontinued many years ago; the Medford Street draw in Malden is now seldom if ever opened.

Along or very near the river are numerous important industrial establishments, one of them the largest of its kind in the United States. Several of these were originally located here on account of good water-front facilities. They turned their backs upon the river long ago; their plants are now organized with sole reference to connections with the railroads on the opposite side. It may be noted that one great establishment in this neighborhood, although its raw material consists exclusively of the coal which it converts into electrical energy for light and power, has no direct connection either with railroad or tide water, receiving all its fuel by teaming from the railroad. Another concern, a great gas company, has all its coal hauled by rail from the Mystic River wharves, about 3 miles away.

The upper part of the Malden River was canalized more than a half-century since. An appropriation for the river was made by Congress a few years ago. The greater part of this has been expended with good results on the lower part of the water way. But although it was provided that the improvement was to be carried as far as Charles Street, the army engineer in charge has recently reported that that part of the river, under present conditions, is not worth improving.

It should be instructive to consider what a modern German city similarly situated would do. It would develop both rail and water possibilities to the greatest advantage. The channel would be deepened by powerful dredgers; by the same means a good-sized basin would be excavated at the head of navigation and the material would be utilized to bring the adjacent marshlands up to the grade demanded for building purposes and good drainage. All about this basin factories would be erected, with good switching connections with the railroads near by. Colliers and other vessels would come to their doors. An efficient lighterage service, organized to serve all points about Boston harbor, would promptly and cheaply carry manufac-

tured products for transshipment to seaboard lines running all along the coast and connecting at southern ports with trunk lines to the west.

Would not such improved facilities for production and transportation give local industries advantages that would enable them to ship much farther afield than now seems possible, and profitably to meet competition in other sections? The possibilities here instanced suggest what might be developed at various other parts of our metropolitan water front.

The commerce of the lower part of the Malden River has been very largely increased by the deepening of the channel. Good-sized coal vessels come to a large yard in Malden, while in Everett an important steel manufacturing plant receives its fuel at a wharf before its doors.

The lower part of the Mystic River, below the Boston & Maine Railroad bridges, is of great commercial importance. Here are the Mystic wharves of the Boston & Maine Railroad. On the north side of the river and on Island End Creek is the enormous gas and coke plant of the Boston Consolidated Gas Company. Here large steamers bring coal from southern ports and from Nova Scotia, with the best of modern equipment for discharging.

At Mystic wharves above Chelsea bridge the Boston & Maine Railroad Company maintains the most extensive coal pockets in Boston; it also has extensive coal wharves between its two bridges farther up the river. At Mystic wharves below the bridge there is an extensive foreign commerce, with steamship lines running to and from many parts of the world. Here at the same wharves there is a large export business in lumber to South American ports. Square-rigged vessels lie continually loading in the large dock on the south side of the wharves.

A new dock, adjacent to the Mystic wharves on the up-river side, is chiefly utilized by steamers bringing sugar and molasses for the great refinery on Millers River in East Cambridge, necessitating a short haul by rail. It has been suggested that, with the approach to Millers River adequately developed, this refinery might receive its sugar from vessels at its own doors, thus equalizing the advantage of direct discharge now enjoyed by its rival on Fort Point Channel.

The Mystic River has possibilities of a vastly greater commercial development. About it lies a great industrial population, and in its widest portion, below Malden bridge, it has the advantage of having only one drawbridge between it and the open harbor.

Island End River, a short tidal creek, might easily be deepened for the service of industries for which this region offers uncommonly attractive opportunities, — the adjacent marshes excavated for commercial basins in the manner suggested for the Malden River region. The Harbor and Land Commission has lately surveyed a new channel for Island End River which, at an estimated cost of $57,200, would develop an important industrial water front here.

The Mystic wharves above Chelsea bridge and the mouth of Island End Creek are now accessible by a channel 25 feet deep at mean low water. The channel, however, makes an awkward bend at the draw of Chelsea bridge; hence the draw is passable only at slack water at the turn of the tide. For this reason it has been recommended by the United States army engineer in charge of this district that the channel be increased to a depth of 30 feet at low water, thus enabling vessels of at least 25-feet draft to pass safely at low-tide slack water.

The commercial development of the Mystic River basin will undoubtedly be extensive, both for the service of the numerous industries in its neighborhood and possibly for the coastwise trade. The latter is now cramped in its accommodations on the water front of the city proper, with no room for expansion there. It has been suggested that ultimately the importance of this basin may call for a traffic tunnel in place of the existing Chelsea bridge, thus giving a clear, unobstructed water way from the open harbor up. Such a solution, necessarily extremely expensive, can hardly be considered as a problem for the more immediate future; but as a possibility it may be held in view. It would have the advantage not only of promoting commercial facilities but would also effectually overcome an increasing interference with the great stream of highway and street car traffic that pours over this bridge in steadily increasing volume. Chelsea bridge is the most direct and important highway connection between the northern and northeastern sections

of the Metropolitan District as far as Lynn and beyond. The inevitably frequent opening of the draw interferes very seriously with the highway. These two essential functions necessarily conflict. Hence, in behalf of transit and street traffic there is an increasing popular demand that the use of the draw be limited to a few stated times of the day. This could not well be done without very seriously affecting the value of the basin, much to the detriment of the industrial and commercial interests that underlie our metropolitan growth. Hence the problem of reconciling these now conflicting public interests must inevitably be dealt with sooner or later.

Another suggested solution proposes a double roadway, with Chelsea bridge branching to include a basin between two draws. This would overcome the difficulty arising from interference with highway traffic. While one draw was open traffic would be diverted to the road connecting with the other draw. The commerce of the basin would thus not interfere with street traffic across it. Such a feature should be far less costly than a tunnel of the length and dimensions necessary. The situation would be something like that at Charlestown and Warren bridges, where traffic may be diverted to one bridge when the draw of the other is open.

When the dam at Cradock bridge in Medford was first proposed it was recommended by the State Board of Health that it be located at Wellington bridge instead. The Metropolitan Park Commission, although agreeing that this would be desirable, felt that while it might be done at some future time, it could not be undertaken then because of the cost involved. A dam at that point might have greatly improved the commercial utilization of the river at Medford and Somerville.

Chelsea Creek.

Chelsea Creek branches from the Mystic between Chelsea and East Boston and runs up into Revere with about 2 miles of navigable water. The commercial uses of this piece of water are important, particularly on the Chelsea side. The East Boston side was formerly chiefly devoted to ship building. The latter has been more neglected, possibly because the steep gra-

dients of the adjacent territory limit industrial possibilities to a narrow margin of water front. The East Boston shore at present is largely used for the storage and repairing of dredgers, towboats, lighters, etc. Farther up the creek lies the extensive plant of the Standard Oil Company, while another large oil concern is located on the Chelsea shore. Altogether, the commercial functions of Chelsea Creek are to the port of Boston very much what those of the Harlem River are to New York. The neighborhood of the creek in its upper portion invites an extensive industrial development. On the East Boston side, for instance, a great cotton factory is projected. It is claimed that the local conditions are exceptionally favorable for this undertaking, with good opportunities for water and rail transportation.

Mystic River: East Boston Front.

On the East Boston shore of the Mystic River, formerly occupied chiefly by ship yards, the uses are now largely miscellaneous; as a whole, not at all such as a deep-water frontage upon an unobstructed channel would naturally invite. There are some large and admirably equipped coal wharves, and the ship-building industry survives in the shape of an important plant now devoted mainly to ship repairing, — a service in constant demand in a great port. Plans for a systematic reconstruction and development of this water front, together with that of Chelsea Creek in East Boston, have recently been proposed in connection with a suggested marginal railroad connecting with the Boston & Albany's Grand Junction line near its crossing between Chelsea and East Boston.

Both for the more immediate uses of foreign commerce and of the coastwise trade this water front, with the present ramshackle and antiquated arrangements replaced by modern docks and wharves, should be of great value.

The Water Front and the Coastwise Trade.

The coastwise trade is at present for the most part confined to the water front of the Shawmut peninsula, or Boston proper. It has grown enormously in volume, being now transacted almost entirely by steamships in place of the small sailing craft

of a half century ago. A chief function of this trade is to supply water connections with trunk lines at points to the south, on the Atlantic seaboard. This makes Boston practically a terminal for these lines as well as for the railroads directly entering the city. The differential rates thus secured to our merchants and manufacturers for freight bound to and from the west by these slower and more roundabout routes, as well as by "the northern gateway," through Canada, are of extreme importance. It is of the utmost moment that the coastwise trade should have opportunity to increase freely and without congestion at the most vital point.

Water-front Deficiencies caused by Private Ownership.

An essential element in this coastwise trade is that its wharves should be as close as possible to the great central mercantile district of the city, to and from which the freight billed over these routes must be hauled. There is little, if any, opportunity for enlargement at the present water front of the city proper. Indeed, the accommodations have been diminished rather than increased in recent years by the conversion of wharf property to other uses than commercial, such as cold-storage warehouses, power stations, etc.; two deep-water wharves were converted to park purposes fifteen years ago, and the old gas house property at the North End has been purchased for railroad yard purposes.

It may be said of the metropolitan water front in general that, as a whole, where purely private ownership prevails, the organization and development have long been wholly inadequate for the needs of modern commerce. The water front of the city proper and that of East Boston on the Mystic River and Chelsea Creek exemplify this defect.

On the other hand, where the water front is in the hands of public-service corporations with transportation functions, or of the Commonwealth, the plan is comprehensive, the results are correspondingly large, and, in a measure at least, the development, actual or potential, is adequate. At present there is nothing to prevent the individual owners who now possess much of the most valuable frontage of the harbor from devoting it to

such noncommercial purposes as may be best suited to their narrow personal interests. These may easily become, as in various cases they have become, absolutely antagonistic to public welfare.

The water front is the most precious possession of a great commercial city and should be kept inviolate for its legitimate uses. Conceivably the entire portion of Boston's water front now owned by individuals might be developed in such a way as absolutely to exclude commercial access. Already this has partially been done, certain water-front properties having proved of more value to their owners when devoted to noncommercial purposes rather than to the normal uses essential to the welfare of the community as a whole.

On the other hand, a public-service corporation is chartered for certain definite purposes. It may not devote property acquired for docks, wharves and terminals to other and conflicting uses. Upon just such considerations New York City has converted a large proportion of its water front from private to public ownership. A commercial utilization is thus assured in perpetuity.

A striking contrast between private ownership and public-service ownership is presented upon the opposite sides of the "lumber dock," between the Mystic wharves and the main shore at Charlestown. One side has been comprehensively developed by the railroad company. Here is a great lumber terminal; large ships, constantly loading for South American ports, present one of the busiest scenes in the harbor. Opposite, some of the privately owned wharves are of little use for modern commerce in their present state; one of them has been converted into a public playground. It may be questioned if, in the interest of the public, the uses to which all the privately owned water front that is of potential value for modern commercial purposes should not be restricted by law, so that noncommercial utilization, however profitable to the owners, would be positively barred.

The coastwise commerce of Boston must have room to expand. There are two directions in which this may take place, northward and southward. The Commonwealth flats are within a

comparatively easy teaming distance of the mercantile center, and might be developed, partially at least, with reference to coastwise trade. The specific purposes hitherto held in view for these flats have been for foreign commerce. For this they offer many advantages, especially by reason of direct connection with the center by bridges rather than by ferry. Hence this part of the water front should be particularly serviceable for great transatlantic liners of the modern combination type, with large passenger accommodations as well as of great cargo capacity.

The removal of the wholesale fish market from T wharf and its vicinity to another portion of the water front in a comparatively near future is unavoidable for the reason that it has outgrown its present accommodations and has no room to expand. The Harbor and Land Commission has strongly advocated the concentration of the fishing interest, one of the most valuable features of Boston's trade, at a convenient point near the extension of Summer Street to the L Street bridge, on the inner basin of the flats. This would be an excellent location, not far from the market and nearer and more convenient to the open sea than the present location at T wharf. A cleanly and well-planned fish market at this point, modern in equipment, would be a most desirable feature of our new water front. The fishing business of this city, which Boston alone of all the great ports of the country carries on, practically monopolizes the fresh-fish trade of the United States and amounting at present to something like $15,000,000 a year, could hardly fail to increase in even greater ratio than heretofore under the encouragement given by such improved conditions. The existing state of things at T wharf is unsanitary and repellent to a degree. Moreover, the transfer of the fish business from this point would release one of the best portions of our deep water front for the great coastwise development to which it is naturally adapted. It seems absurd that available deep-water facilities, urgently needed for large commercial purposes, should be occupied by hundreds of small and light-draft fishing vessels. It seems much like devoting a dry dock, built for the accommodation of great ocean liners, to the repair of dories and row boats.

The transfer of ocean liners from their present accommodations at the Hoosac Tunnel Docks to more convenient, newly developed points would release for the coastwise trade a very considerable amount of pier room within easy teaming reach of the mercantile district. For that purpose they would also have the advantage of being admirably served with railroad connections. It has been suggested that, with the development of great ocean terminals at other parts of the water front, these docks might be disposed of by the railroad company. But their retention and utilization for coastwise trade would seem the better way to deal with them. With the reconstruction of the Boston & Maine approaches to the North station considerable quay room would become commercially available. This might be utilized for the transfer of package merchandise between railroad freight sheds and lighters connecting with coastwise or foreign steamers.

As previously indicated, the now antiquated Mystic River water front of East Boston, opposite the navy yard, might be developed, in part at least, for the coastwise trade. The drawback here is the necessity of communication by ferries. Special ferry accommodations might overcome this obstacle in great part. It has been suggested that the present ferry boats could be given a greatly increased capacity by devoting the entire main deck to teams, while the upper deck could be utilized for far better passenger accommodations than exist under the present arrangement. Moreover, it should be borne in mind that the substitution of mechanical for animal traction, which must take place within a comparatively few years, will enormously increase the conductivity of our streets and ferries.

It has been proposed to develop this portion of the East Boston water front for the coastwise trade while retaining at the water front of the city proper the present wharfage facilities for its steamships. This would be brought about by transferring cargoes between the steamers and the East Boston water front by means of lighters and car floats, cargoes there to be transferred by railroad connections to and from points of shipment in the interior. The possible utilization for coastwise trade of that portion of the Charlestown water front on the

Mystic basin yet undeveloped in a modern sense has been indicated. It may here be pointed out that the water front at this point is nearer the mercantile center than is the remoter portion of the Commonwealth flats. Better teaming routes across Charlestown would, however, have to be devised.

South Bay and Fort Point Channel.

On the easterly side of what was Boston Neck is South Bay, now very considerably diminished in area — its flats largely filled in for industrial occupancy. At its upper end is Roxbury Canal, about a quarter of a mile in length, with half a mile of water front. Fort Point Channel connects the bay with the harbor. It is crossed by nine bridges, including Mt. Washington Avenue bridge. Officially the latter still exists although discontinued, — possibly only temporarily. The next to the newest of these, the Atlantic Avenue bridge, may be cited as an instance of the almost absolute waste of the $1,250,000 and more expended by the city and the railroad company in its construction; the bridge with its considerable gradients turns out to serve no useful purpose and goes practically unused.

Notwithstanding the obstacles to water traffic interposed by these bridges, the commerce of the South Bay and Fort Point Channel is very large, reaching to a figure as high as 1,800,000 tons a year. This, both in bulk and value, represents a greater business than that of any Atlantic port of the United States south of Chesapeake Bay or north of Boston.

From the Northern Avenue bridge to the end of the Roxbury Canal the distance is about 2 miles. Adjacent to the westerly shore of the South Bay and the canal is the great central lumber district of Boston. Square-rigged vessels not infrequently load in the Roxbury Canal for South America with hardwood lumber cut and manufactured in the interior of Connecticut and brought to Boston by rail for export.

To the wharves of the lumber district, which are served by the Albany Street freight tracks of the New York, New Haven & Hartford Railroad, lumber of all kinds is brought from coastwise points all the way from Maine to the south and also from the maritime provinces of Canada. On the South Bay and Fort Point Channel are also important coal wharves.

One of the greatest items in the commerce of this arm of the harbor is supplied by the sugar and molasses brought in steamships to the great refinery in South Boston from many ports in the West and East Indies and South America.

Notwithstanding the high commercial value of the South Bay and Fort Point Channel, it has been urged in influential quarters that considerations of true economy would induce the filling in of these waters for conversion into valuable land for mercantile and industrial uses. It is argued that the commercial needs now supplied here could better be served by the occupation of undeveloped water front farther out, such as, the Commonwealth flats, Old Harbor and on Dorchester Bay.

On the other hand, it is represented that arms of the harbor like this are of immense value, both actual and potential, to the metropolitan community in providing convenient water carriage for lumber, coal and other bulky material for the service of neighboring populations, thus saving high charges for cartage or for railroad hauling from remote parts of the water front. By water such supplies are cheaply and conveniently brought close to the points where they are to be utilized, while manufactured products can be carried away by the same means, either in vessels bound direct to their destination, or by car floats, barges and lighters, to be transshipped to vessels at the outer wharves.

Old Harbor and Dorchester Bay.

The remoter water front of Boston Bay remains to be considered. One of the most notable features of the studies recently made by the Boston Society of Architects' Committee on Metropolitan Improvements — studies which were a determining factor in leading to the creation of this commission — was the project for extensive docks and freight terminals designed for the accommodation of a gigantic commerce, made by Mr. Theodore M. Clark, the architect, who deserves credit for an able presentation of the subject, based upon careful studies of European ports.

Mr. Clark's plans devote practically the entire space now occupied by the shallow waters of Old Harbor, originally the port for the first settlement of Dorchester, to long lines of broad piers, with correspondingly broad docks between, — the piers

to be occupied by modern warehouses equipped with mechanical facilities for the transaction of a great commerce.

A prime merit of this scheme was its immediate access to deep water by way of the great channel that runs from the main harbor past Thompson's Island to the mouth of the Neponset River.

To its disadvantage must be reckoned the practical destruction of the great and costly park improvement known as the Strandway. Recreative features, to be sure, should not stand in the way of commercial and industrial development; purely as a question between the two, the latter should by all means prevail. But if commercial demands can with equal convenience be provided for elsewhere, the destruction of existing recreative improvements, carried out at great cost, would be wholly unjustifiable. By transferring the improvements proposed at Old Harbor to points not much farther southward, the same needs, to all intents and purposes, might with equal facility be reached. Such an opportunity is apparently presented by the water frontage of the peninsula bearing the historical name the Calf Pasture. This would simply transpose the area of improvement a half mile or more to the southward, leaving the South Boston shore of Old Harbor and Dorchester Bay to its present uses.

Other opportunities for a high-class commercial development are presented on the shores of Dorchester Bay near the mouth of the Neponset River, — at Commercial Point on one side and on the extensive tract of marsh and upland at Little Squantum on the other, — a territory acquired by the New York, New Haven & Hartford Railroad Company some years ago.

The Calf Pasture location, in accessibility from the mercantile center, would practically be as advantageous as that suggested for Old Harbor. The locations farther south, though considerably more remote, apparently would be capable of desirable development for certain classes of commerce, similar to those to which the Bush Terminal on the Brooklyn side of New York Bay is devoted.

Weymouth Fore River.

Another highly important location for commercial development is presented on and about Weymouth Fore River, including Town River Bay in Quincy. The deep, approaching channels would accommodate the largest class of modern steamships.

The neighboring region may at no distant day be the scene of a very important commercial and industrial development. This would create a large urban population for the municipal group comprising Quincy, Braintree and Weymouth. A manufacturing plant of the greatest importance, both industrial and commercial, has within a comparatively few years grown up at Quincy point in the shape of the largest ship-building company in the United States. Near by, on Weymouth Back River, the national government has acquired a great tract of land and is establishing there the largest naval magazine in the country. To this location will be transferred the magazine now located on Island End River in Chelsea, perhaps releasing for industrial and commercial uses a large tract of land now owned by the national government in that immediate neighborhood.

With the proposed ship canal between Boston Bay and Narragansett Bay — from Fore River, by way of Whitman and Brockton to Taunton River — once realized, this location would gain a high strategic importance, commercial and industrial. Extensive dock and terminal improvements at this point would naturally then take place.

Here may be noted the close analogy which possible developments on the Quincy, Braintree and Weymouth shores and at a corresponding distance from the metropolitan center on the north side of the bay bear to similar developments proposed for New York. The possibilities of Weymouth Fore River and its vicinity may be compared with those projected for the city of Newark, N. J. The former relates to Greater Boston much as Newark relates to Greater New York. The Fore River estuary and Town River Bay are arms of the great landlocked piece of water known as Nantasket Roads, — enclosed by Hough's Neck, Peddock's Island, the L-shaped peninsula of Hull and Nantasket. Newark lies upon the Passaic River, adjacent to the

waters of Newark Bay. Nantasket Roads and Newark Bay are portions of the inner bays of the respective great ports, the entrances of each being inside the Narrows.

Lynn Harbor.

On the opposite side of Greater Boston, at the same distance from the metropolitan center, lies Lynn harbor, — the commercial water front of one of the largest populations and greatest industrial communities in the Metropolitan District. Lynn harbor, enclosed by Nahant and forming an arm of the outer bay, lies without the Narrows. In its situation it bears a striking resemblance to that of Jamaica Bay on Long Island, — the scene of an important development of commercial and freight terminal facilities proposed, or contemplated, in the interest of the Pennsylvania Railroad Company.

Lynn harbor, with adjacent inland waters, relates to the city of Lynn much as Jamaica Bay relates to the borough of Brooklyn. The estuary of the Saugus River and the inlet known as Pines Creek should have important industrial and commercial possibilities in relation to the extensive territory of the Saugus and Lynn marshes. This territory appears to invite extensive manufacturing, and possibly residential, development.

In Lynn, upon the Saugus River, stand the " river works " of a gigantic electric manufacturing corporation. By way of the river, coal and other bulky raw materials are brought to these works, indicating what may be done for other important industries that will doubtless find advantageous locations hereabouts.

Lynn harbor not many years ago consisted of mud flats threaded by very shallow channels, and was of comparatively little value commercially. It is well sheltered by the protecting arm of Nahant, and the main channel has been so deepened as to make the harbor of very considerable value for local commerce, even in its present condition.

The very wide-awake manufacturing and mercantile community of Lynn appears to be keenly alive to the possibilities of the harbor, and is considering an ambitious project for its development that would provide extensive docks and railroad freight terminals as well as valuable sites for industrial uses to

be created from the dredging of the harbor to a depth which would accommodate the largest steamships.

Of all metropolitan communities Lynn has enjoyed in recent years the greatest and most varied industrial development. Commercial facilities that would immediately serve it should prove of corresponding value, promoting a growth even more rapid than that which Lynn has witnessed since it became the seat of a great electrical industry which in magnitude now rivals the shoe trade.

In this connection may be mentioned a study made for the Metropolitan Park Commission, looking to a long causeway across the harbor from the Point of Pines to Nahant. This would have appreciable advantages in connection with the Greater Boston system of parks, parkways and boulevards. Its possible relations to the development of the harbor deserve careful study. As a breakwater it would apparently be advantageous in protecting commerce from a long sweep of wind from the southward and southeastward.

In conclusion, it may be noted that apparently here on the north, and at Fore River on the south, are possible seats of the greatest commercial development on Boston Bay that will take place outside of the metropolitan center.

Noncommercial Uses of the Water Front.

The development of the shores for purposes other than commercial deserves some consideration. These purposes are in the main industrial, mercantile, residential and recreative. Industrial and mercantile uses may very properly be associated with commercial; but when a development is such as to exclude the commercial it may become highly detrimental, as has been seen in the case of the water front of the city proper.

Many parts of the water front, unsuitable perhaps for commercial purposes, are utilized for industrial plants. They are often attracted to such locations by the cheapness of land; also in great measure by the need of having large bodies of cold water at hand for condensing purposes. Conspicuous examples of this sort are the manufacturing establishments at Cambridgeport and East Cambridge, bordering the Charles River and Millers

River, and the various plants for the generation of electric light and power on the water front in the city proper, South Boston, Charlestown, Cambridge, etc.

Often this industrial occupancy is attracted to the shores of the harbor and its branches at places where the water is shallow, and hence not at all valuable for commercial purposes. In such cases the development discourages or repels a high-class residential occupancy that otherwise might be attracted by the neighborhood of the water, the beauty of the shores and the prospects therefrom. Such occupancy is repelled either by the unsightliness of the industrial establishments, the character of the populations that grow up about them or by nuisances arising from such establishments, — as in the case of rendering plants at certain points bordering the harbor or established upon its islands, or of other industries that taint the atmosphere.

Foresight in the distribution of these various utilizations of the water front is necessary for a community that wants to grow intelligently. Intelligent growth requires planning that looks well to the future and to the reconciliation of the diverse elements which enter into its character, — elements that surely would conflict and thereby antagonize the well-being of the community as a whole were this necessity not considered. In the planning of modern population centers in Europe these aspects are given full consideration.

The residential value of the water front in the neighborhood of Boston, as well as along the entire New England coast, is an invaluable asset in the prosperity of the community concerned. This value bears a close relation to the other form of development alluded to, the recreative. In the creation of parks, boulevards and other pleasure grounds Boston stands in advance of all other great cities. The far-reaching project of metropolitan parks included as a chief feature a judicious utilization of the water front. The late Charles Eliot, in his memorable reports on the subject, laid particular stress upon the importance of devoting to recreative uses such portions of the water front as might not be available for commercial purposes by reason of shallow water or other drawbacks, — thereby preventing objectionable developments that would discourage forms of occupancy

advantageous for the entire community. This principle has been intelligently carried into effect. Many miles of water front upon the bay and its branches have been improved for park purposes. It will be observed that in the main these developments have been at points where the water is shallow or the frontage is otherwise unsuitable for commercial uses; and that they also serve the recreative demands of large populations close by, and hence are often bordered by high-class residential districts, whose permanence they thus assure.

The city of Boston in this way has constructed the Strandway and Marine Park along the shallow foreshore of Dorchester Bay and Old Harbor. The city of Cambridge has devoted almost its entire water front upon the Charles River to park purposes; the city of Boston, together with the Metropolitan Park Commission, has dealt likewise with the greater portion of the opposite shore.

At Wood Island Park in East Boston the adjacent waters are shallow. The same is to be said of the metropolitan park improvements on the Quincy shore, at Nantasket Beach, the Winthrop shore, Revere Beach, Nahant Beach and the Lynn and Swampscott shores, — all of these fronting either upon shallow waters of the harbor and bay or upon the open ocean.

Upon the Mystic River, also, above Wellington bridge the Metropolitan Park Commission and the city of Medford have acquired the larger portion of the water front for recreative uses.

It therefore appears that in the greater part of this recreative water-front development only commercially unavailable parts of the water front have been taken. Adverse criticism has been made, however, of these park undertakings to the effect that certain important properties available for commercial purposes have been included. To some extent this objection may be justified. For example: in planning the Strandway at South Boston an extensive coal wharf property was left on the inner side, thus providing a basin accessible by a drawbridge. It was suggested to the author of the design, the senior Frederick Law Olmsted, that such a commercial and industrial property adjacent to a pleasure way might be objectionable. He replied

that on the contrary he regarded it as a desirable feature, since the presence of shipping picturesquely enhanced the interest of the scene. Nevertheless, this property was afterwards taken at a large cost and was included in the parkway grounds.

On the part of the mercantile community strong objections were made to taking the wharf properties at what is now North End Beach for park purposes. Playground room was sadly needed at the North End and this property proved the cheapest and most desirable that could be obtained. In behalf of the step it was urged that the wharves, although fronting on what was naturally the deepest part of the harbor, had fallen into disuse for the reason that in length the docks were inadequate to the requirements of modern commerce. It would now appear that a new dock, with wharves of a shape similar to the recreation piers there constructed, might have provided most convenient accommodation for shipping at that point. The present utilization of the property for recreative purposes is undoubtedly of immense value to the congested neighborhood. Still it should be borne in mind that it has diminished by so much the water frontage available for coastwise commerce. It has been suggested that in a degree, at least, similar ends might have been obtained by utilizing for pleasure purposes flat or terraced roofs of wharf sheds, thus uniting the two important functions in a combination commercial and recreation pier.

On the south side of the Mystic River three water-front properties have been taken for playground purposes. One of these is the Mystic playground, fronting on what is known as the lumber dock; near Charlestown Neck are the second and third, — the extensive Charlestown playground, for which the old mill pond at that place was taken and filled in, and Dewey Beach near by. The two latter have always been unavailable for modern commercial purposes, owing to the shallow water; perhaps they might have been reserved for future commercial development, but for present needs their great recreative value apparently outweighed a remote contingency.

On the Charles River basin the Charlesbank property originally consisted of antiquated lumber, stone and coal wharves, etc., long ago taken for park purposes; opposite, on the Cam-

bridge side, similar wharves were taken by the Cambridge park commission for playground uses. The Charlesbank was of little worth for commercial uses, and has been of unspeakable recreative value for the congested population near by. Under the conditions established by the full basin, the whole water front below the West Boston bridge on the Cambridge side might have been commercially developed to serve with much advantage the adjacent industrial sections.

It may here be suggested that the example of Antwerp and other European ports might profitably be followed in future planning of water-front properties by attractively combining recreative and commercial functions. For instance, the full commercial utilization of the quay room might be carried out while utilizing the roofs of substantially constructed wharf sheds, built say of reinforced concrete, as waterside promenades. It should not be forgotten, however, that the congested population of East Cambridge stands greatly in need of playground accommodations, just as does that of the old West End on the Boston side.

On the open Charles River basin, below the great bridge, but little quay room is left for ocean commerce — that is, of the sort transacted in vessels with masts — directly upon the river front. But it should be remembered that the two canals near by serve as docks with something like 2 miles of water front for such vessels.

Cambridge, as we have seen, has taken nearly all of its water front on the Charles for park purposes; the same holds true of the metropolitan park department on the Boston side. It may be questioned if it would not have been better to leave undisturbed the more important plants — coal wharves, lumber docks, etc. — on either side, carrying the park roads around them in some convenient and not unattractive fashion. As Mr. Olmsted maintained, the presence of vessels discharging or loading would have enlivened the river scene, and would have added to the interest of drives or walks along the shores, while the neighboring populations might have been served by cheaper facilities for supplying coal, lumber and other materials.

On the Mystic River, as likewise has been seen, the greater

part of the shores above Wellington bridge has been taken for park purposes. In behalf of what has been done it has been claimed that future industrial needs have been amply provided for by leaving the banks of the river, in its industrially most valuable sections, free for commercial and manufacturing development. It has also been urged that for the neighborhoods above that point it was desirable to encourage a development which would house a large suburban population, and keep it free from degenerating into the slum-like character which the form of industries that resort to cheap riverside lands would encourage.

It may be suggested that should industrial development in certain places along the remaining portion of the river ever appear desirable in conjunction with commercial facilities, possibly the sites may be released from park jurisdiction for the purposes, under restrictions which would assure for such occupation an inoffensive and even attractive character. The presence of shipping at a wharf on the Neponset River at Milton Lower Mills, just below the falls, picturesquely contrasting with the sylvan aspect of pine groves and rocky shores close by, offers convincing evidence of the beautiful impression that may be produced by associations of commerce with park-like charm.

As for the rest of the metropolitan water front, so far as it has been occupied for park purposes no reasonable objections can be raised that property available for industrial and commercial uses has been taken.